Armed Forces College Of medicine
AFCM

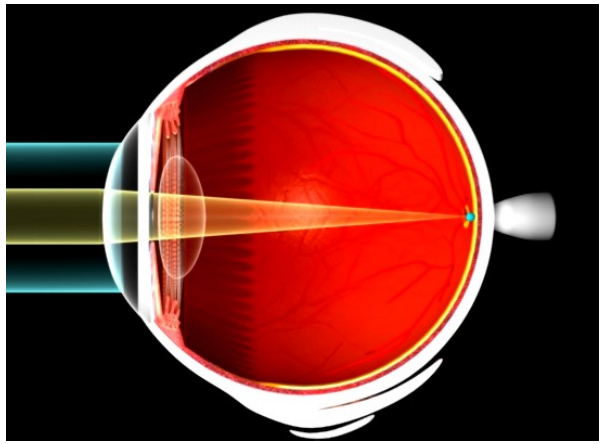
Basic Ocular Anatomy , Examination and Investigation

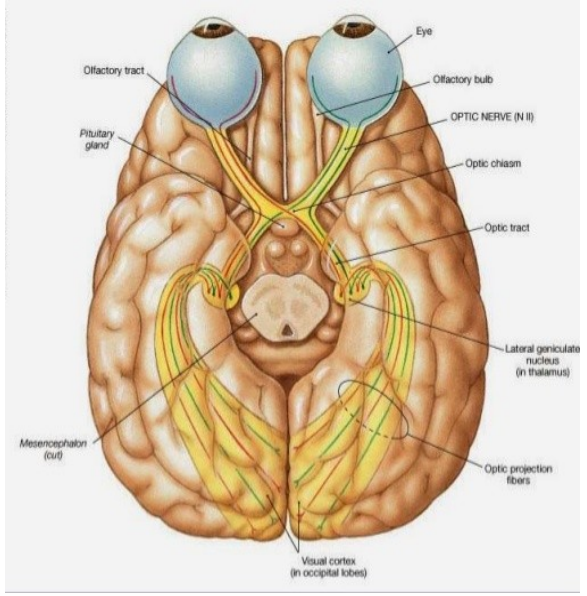
Basic Anatomy

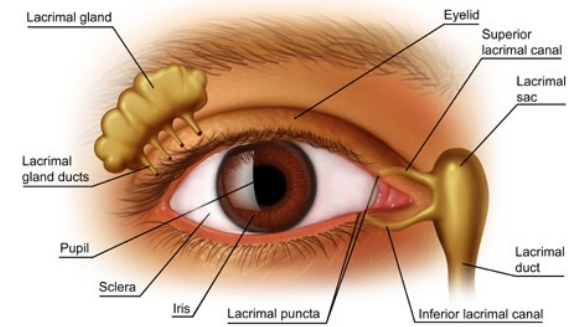
- The eye is the organ of image capture, the optic nerve and visual pathway is for the transmission of signals while the occipital cortex prints the signals from the eye.

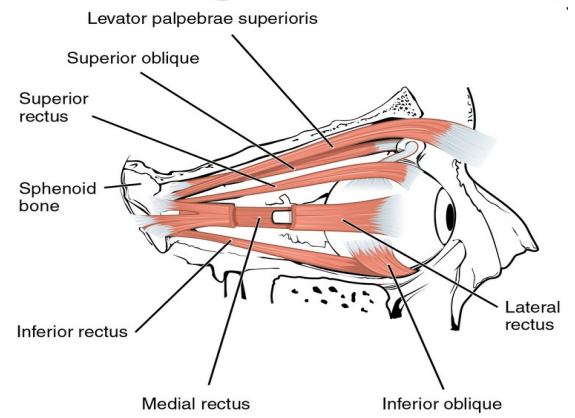
- The eye consists of the eyeball (globe or oculus) and other structures essential for the integrity and function of the eyeball

  - Eyelids
  - Conjunctiva
  - Lacrimal system
  - Extraocular muscles
  - The Bony Orbit with its contents









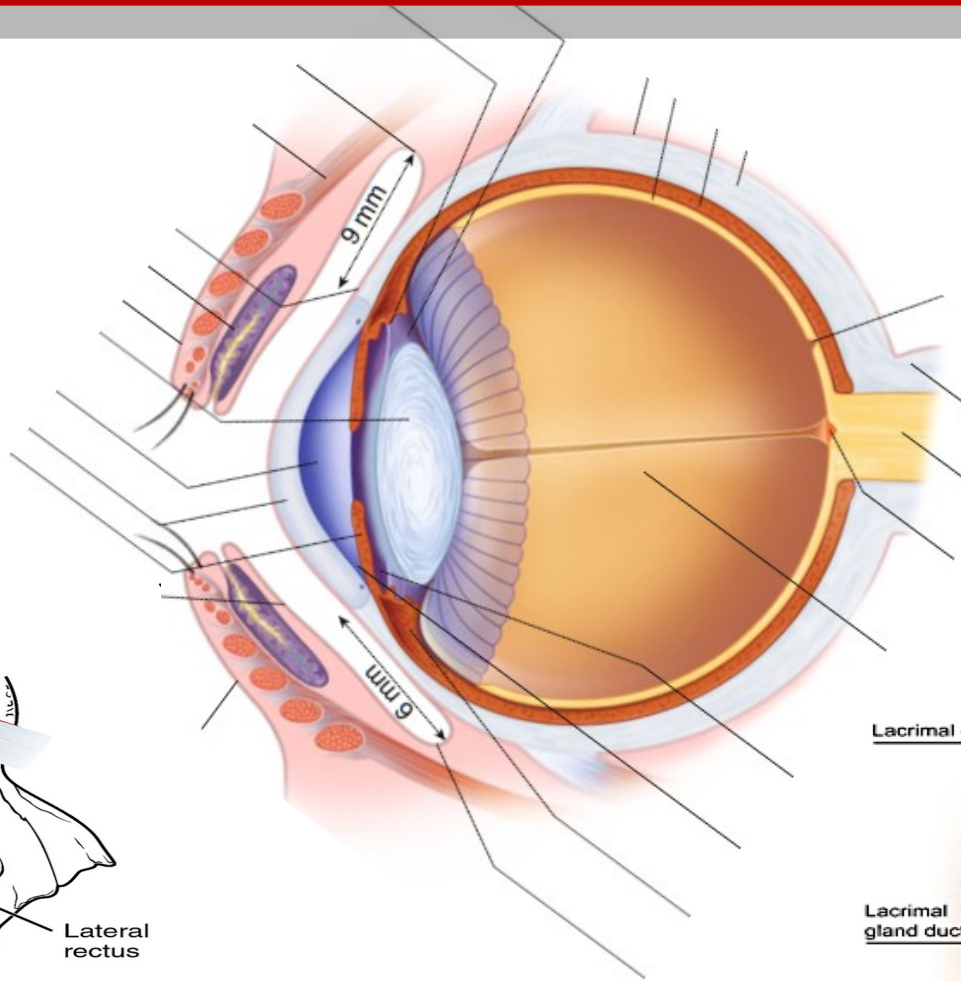
Basic Ocular Anatomy

Adnexa

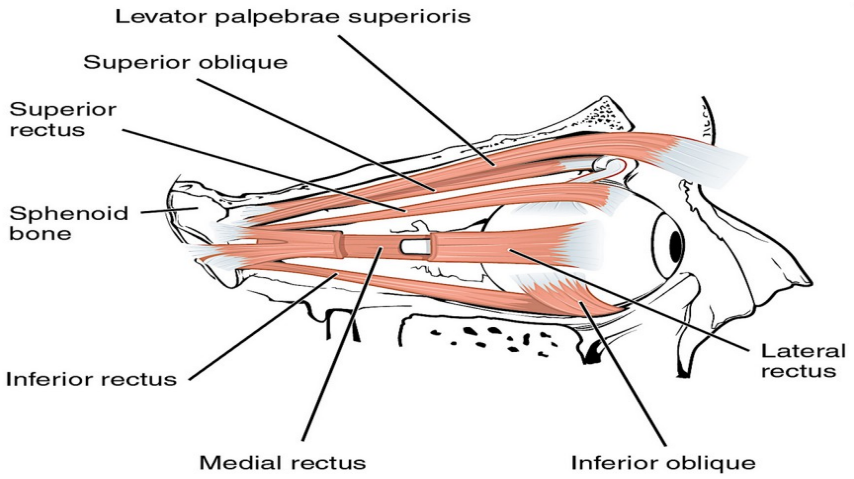
Lids

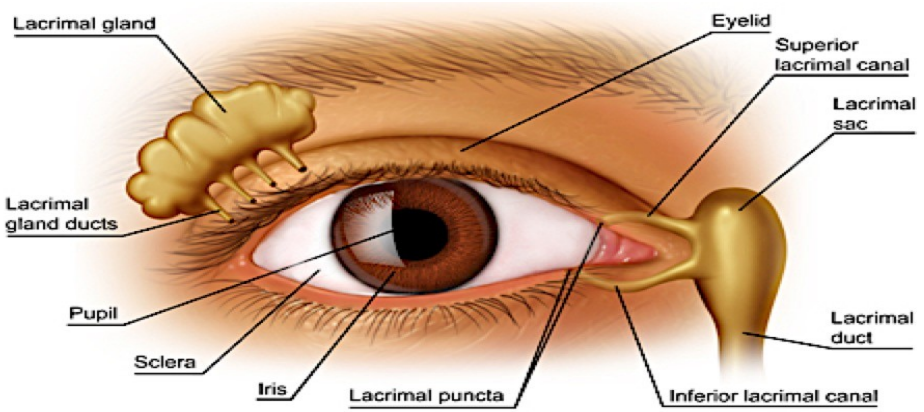
Conjunctival sac

Lacrimal system



Globe
(Eyeball,
Bulbus)





Eye Development

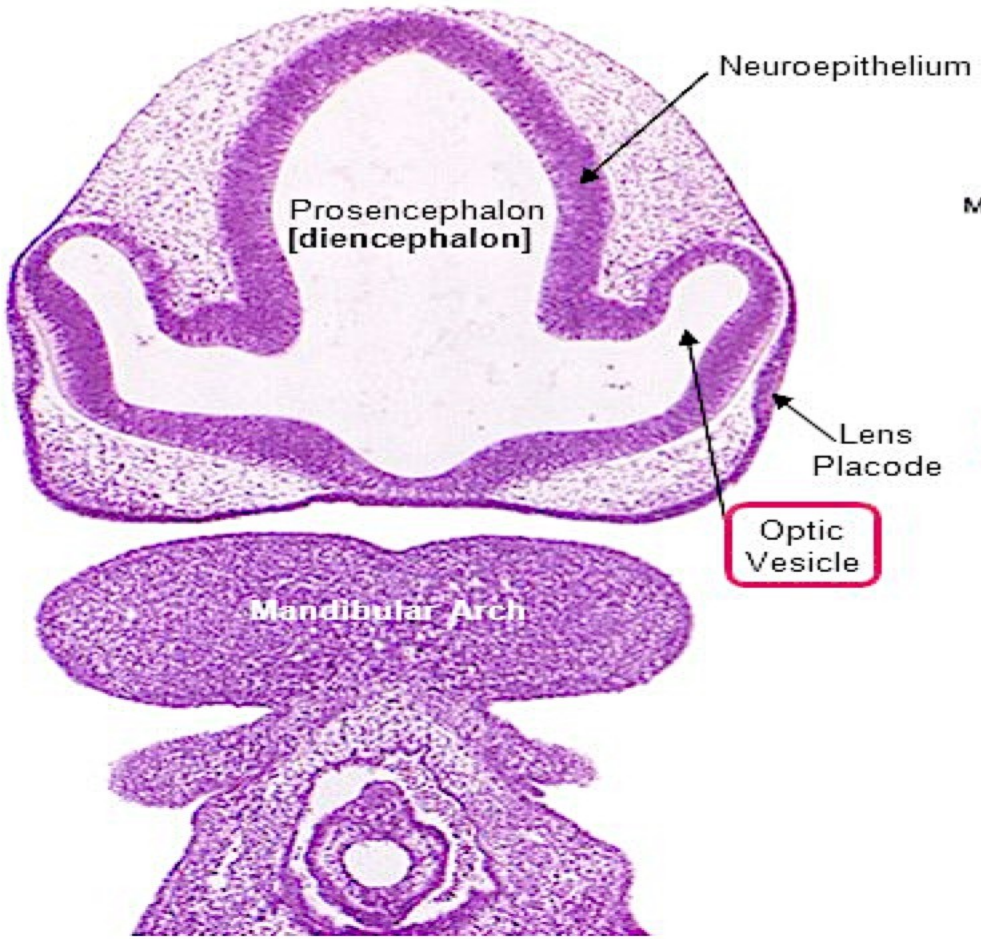
Optic Grooves

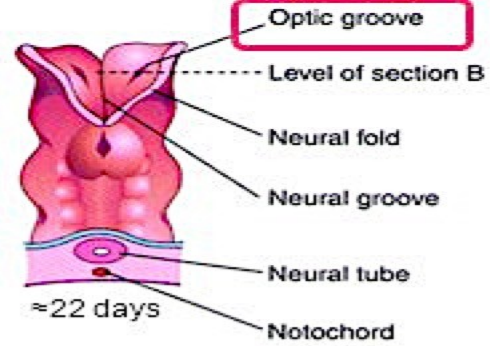
⬇

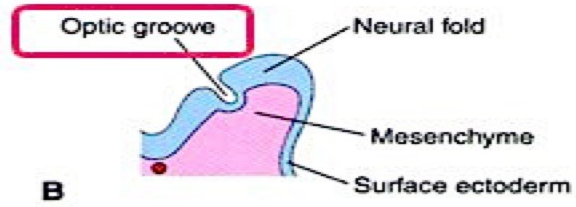
Optic Vesicles

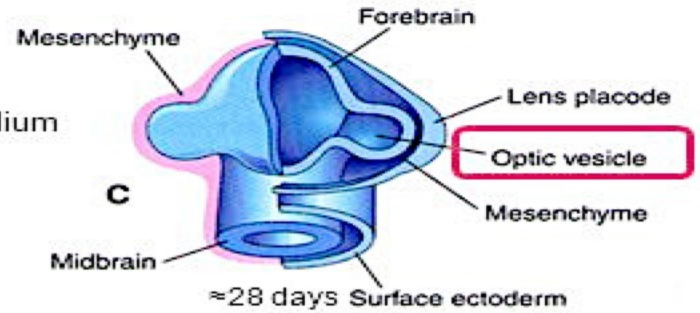
⬇

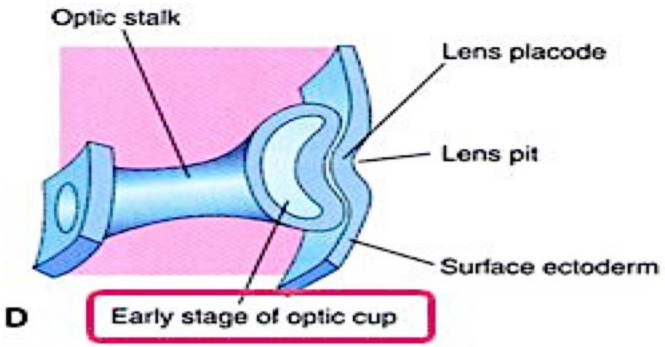
Optic Cups

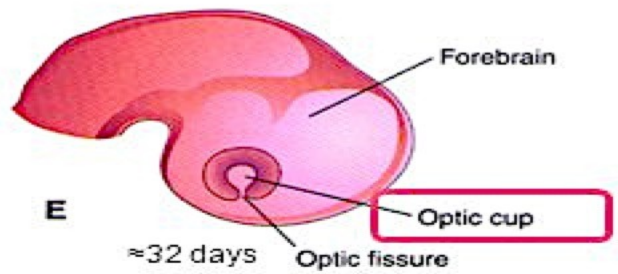


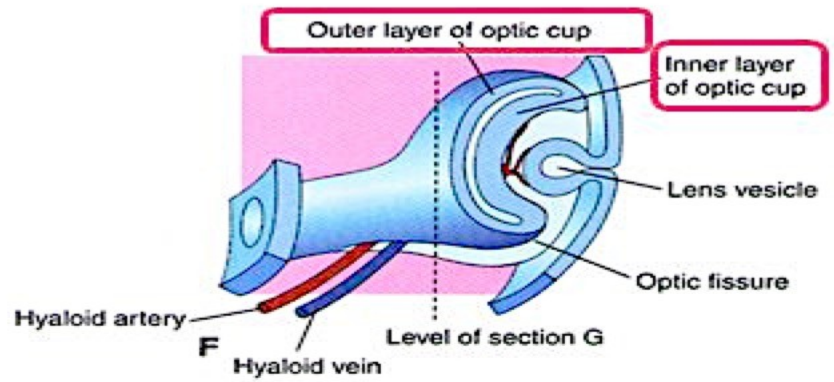


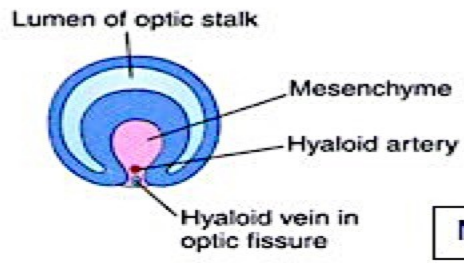


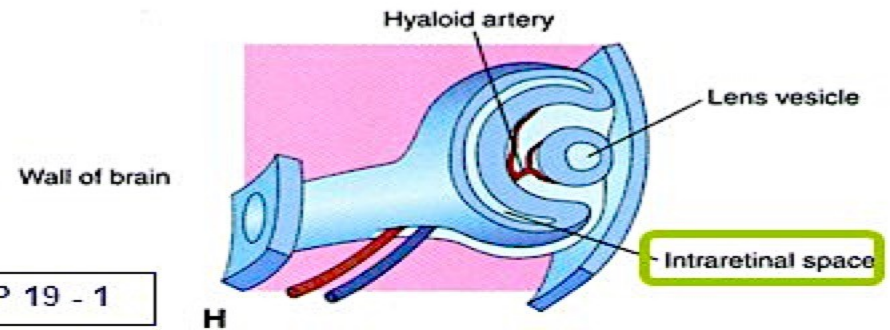








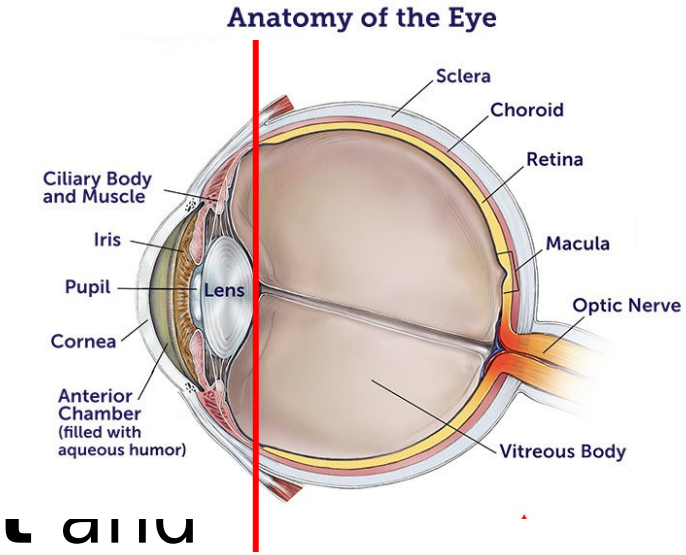




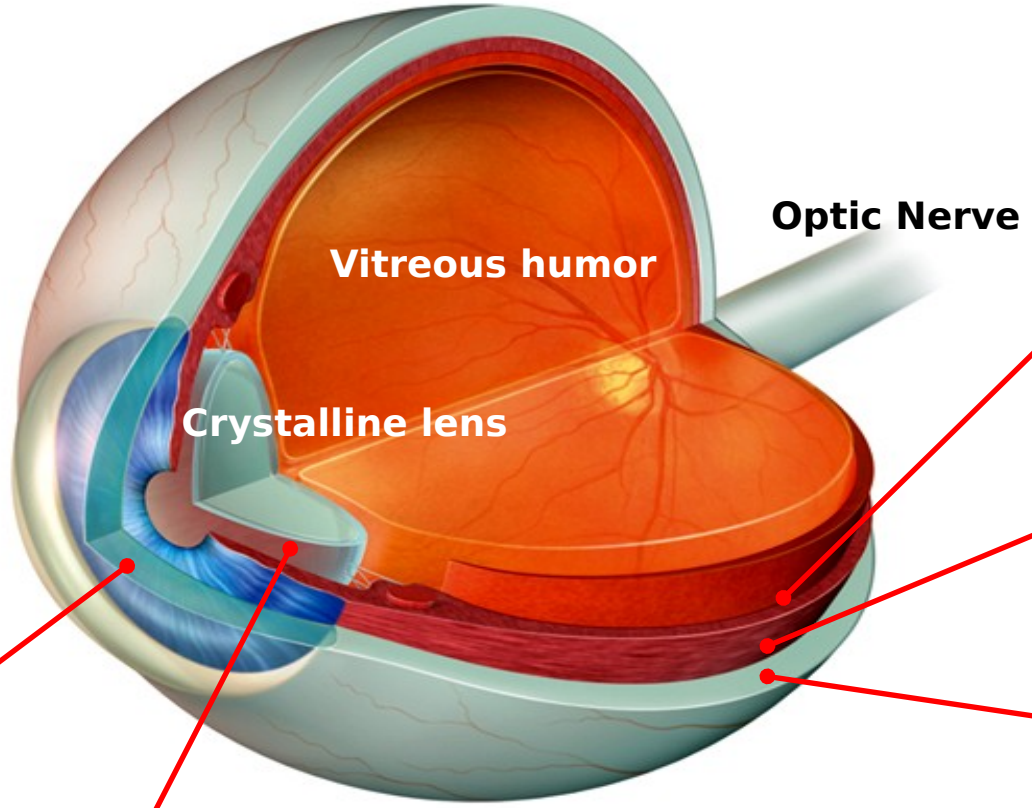
M & P 19 - 1

The Globe (Oculus)

- The eyeball has 3 distinct coats
  - Outer protective strong coat formed of the cornea and sclera
  - Middle vascular coat for nutrition and heat regulation called the uvea
  - Inner neural layer called the retina
- It has 3 spaces
  - Anterior chamber in front of the IRIS
  - Posterior chamber behind the IRIS
  - Vitreous cavity between the lens and the retina
- It is generally divided into **anterior segment** and **posterior segment** at the posterior surface of the lens



Basic Ocular Anatomy
Layers of eyeball



Inner [neural] layer Retina

Middle , vascular , nutritive Layer Uvea

Outer , fibrous , protective Coat

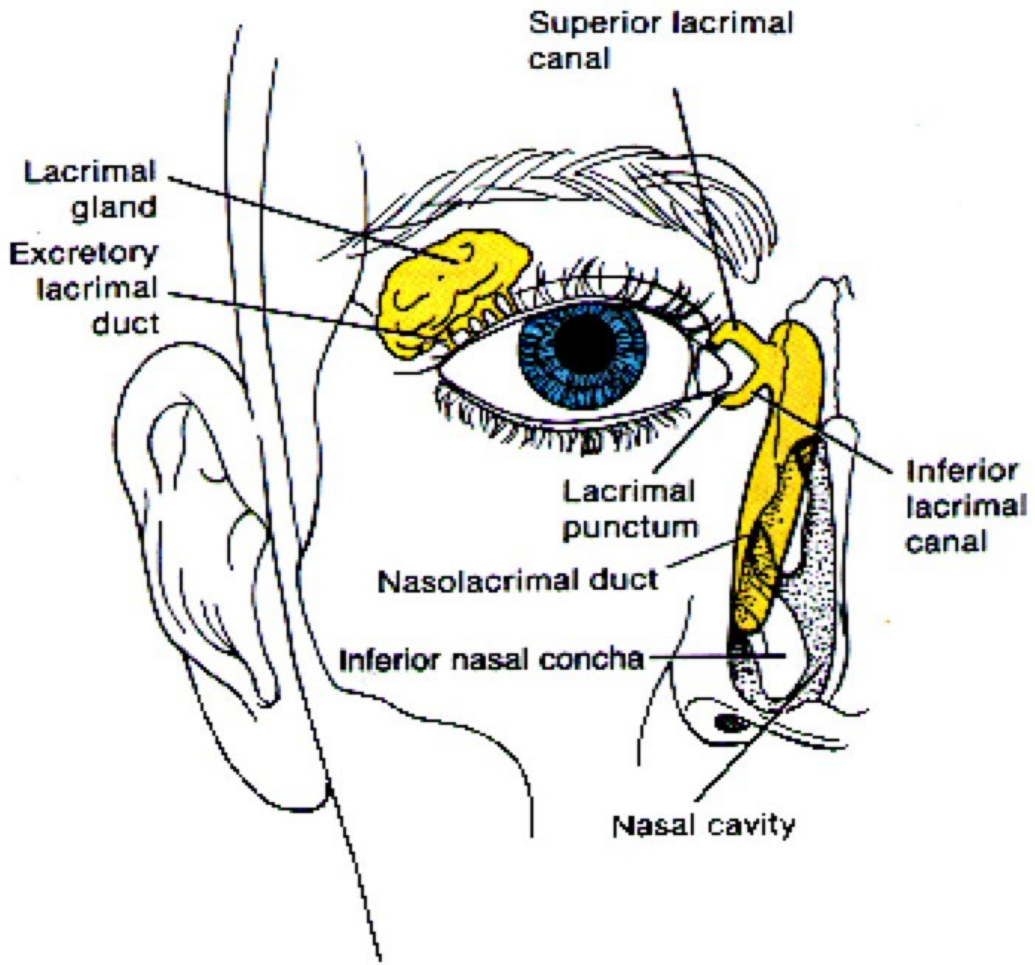
The Lacrimal System

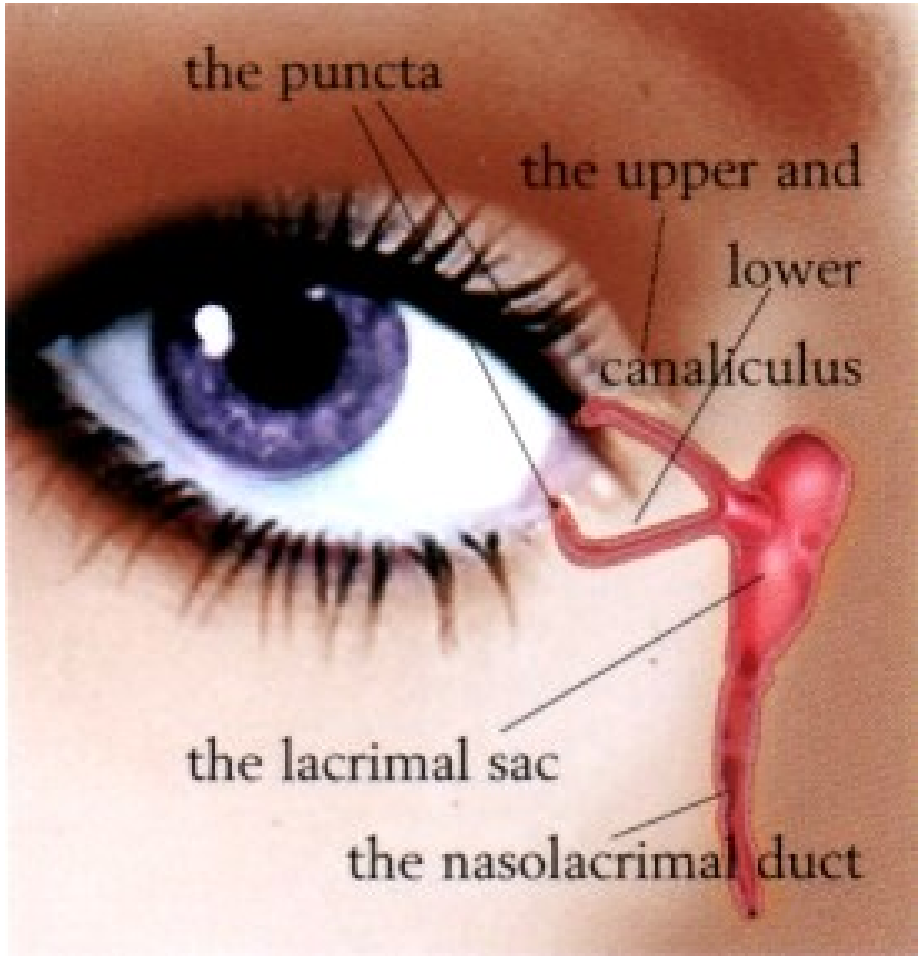
Secretory

Systen

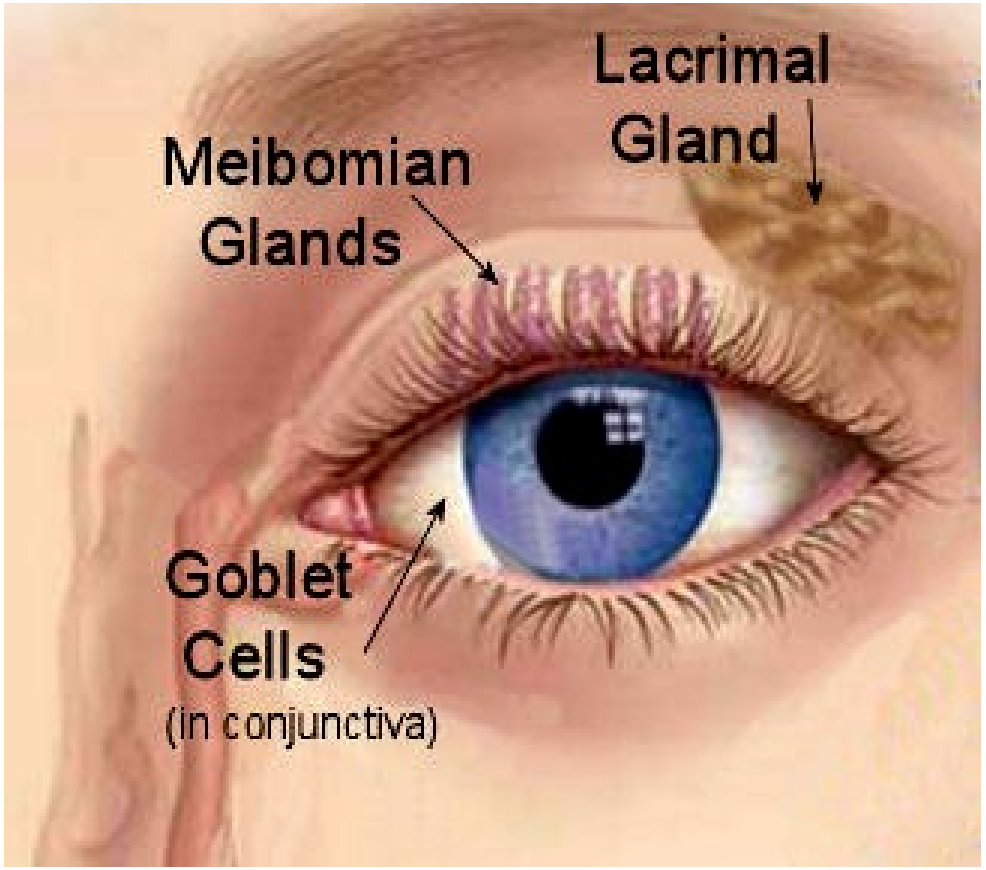
Drainage

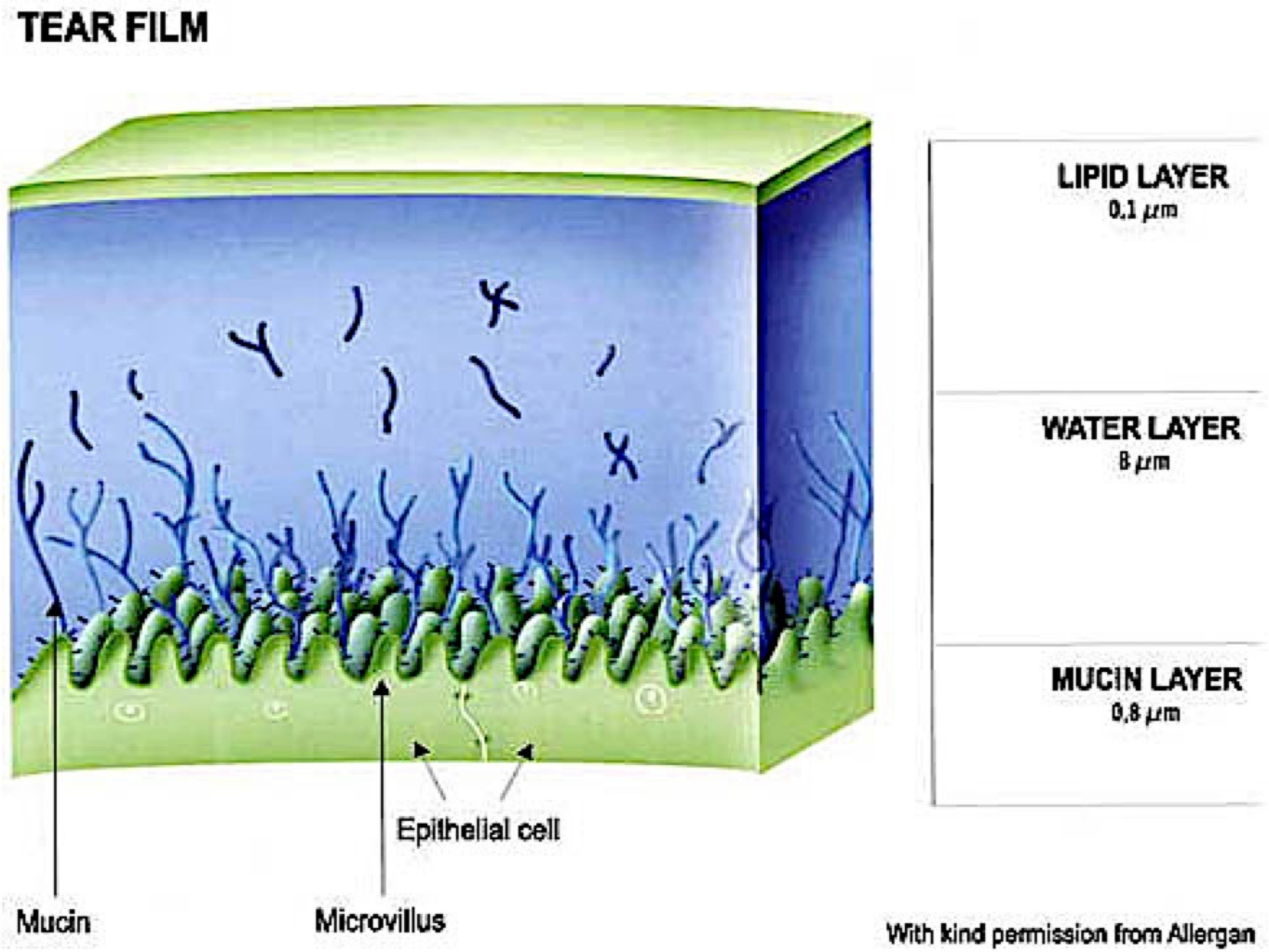
Syster



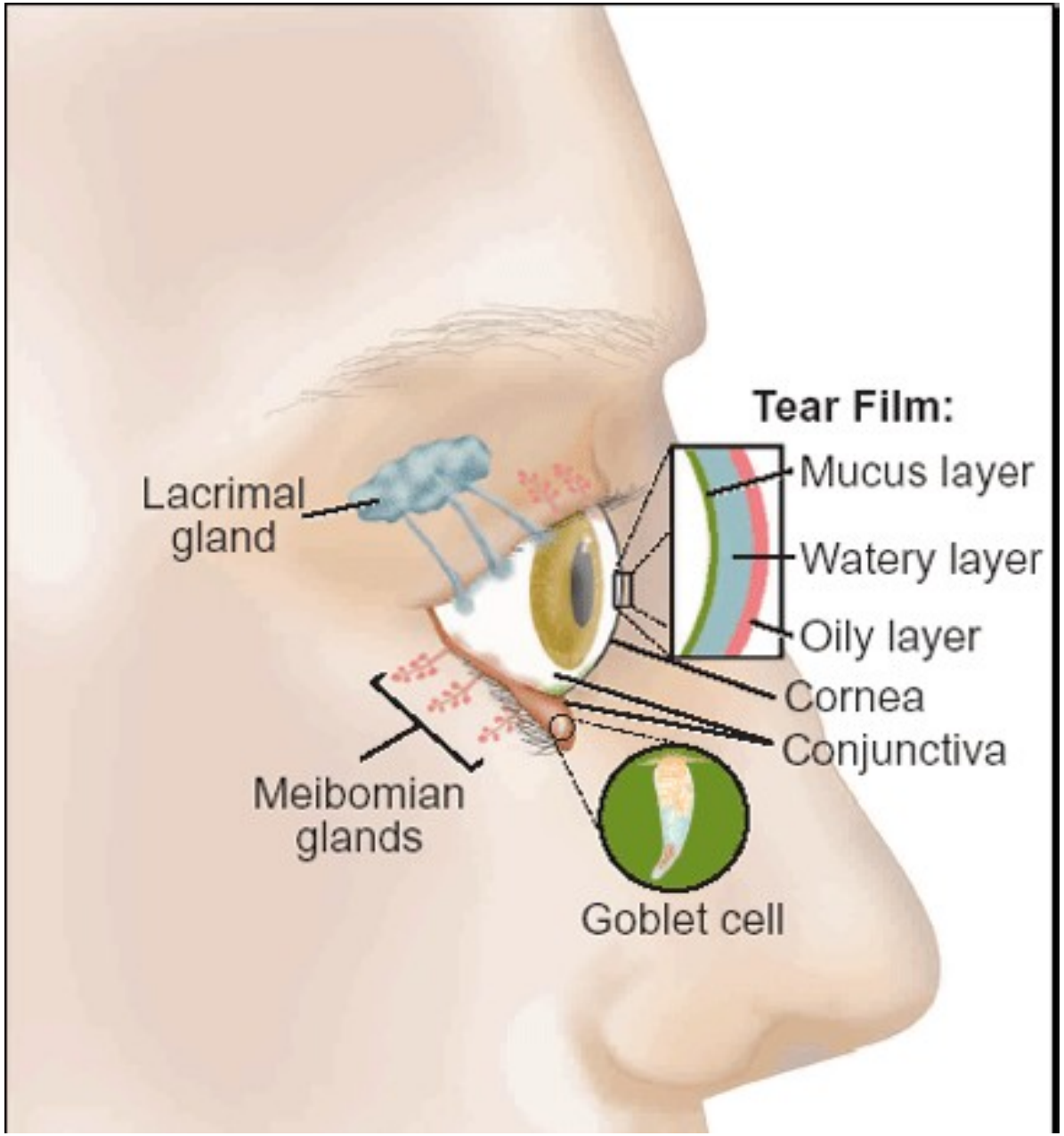


Pre corneal Tear Film



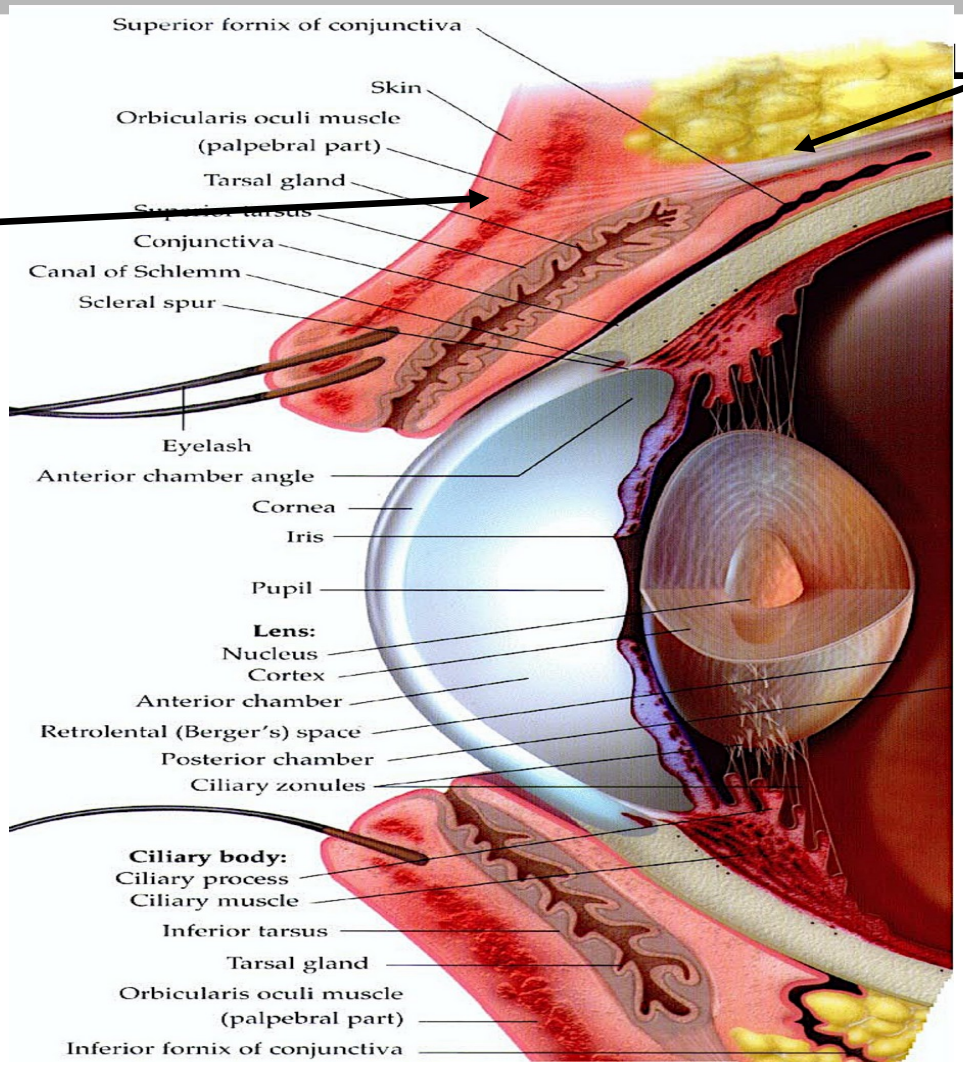


Pre-corneal Tear Film

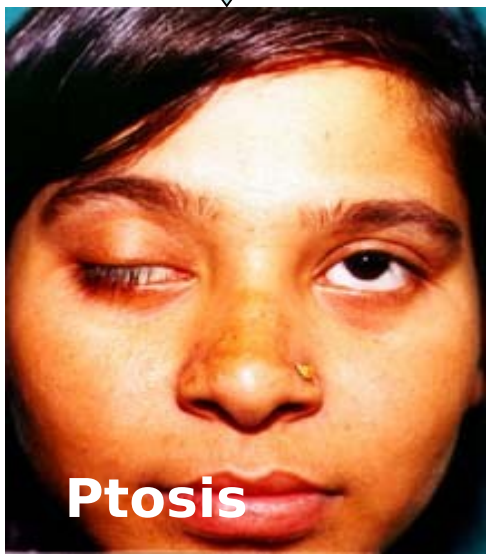


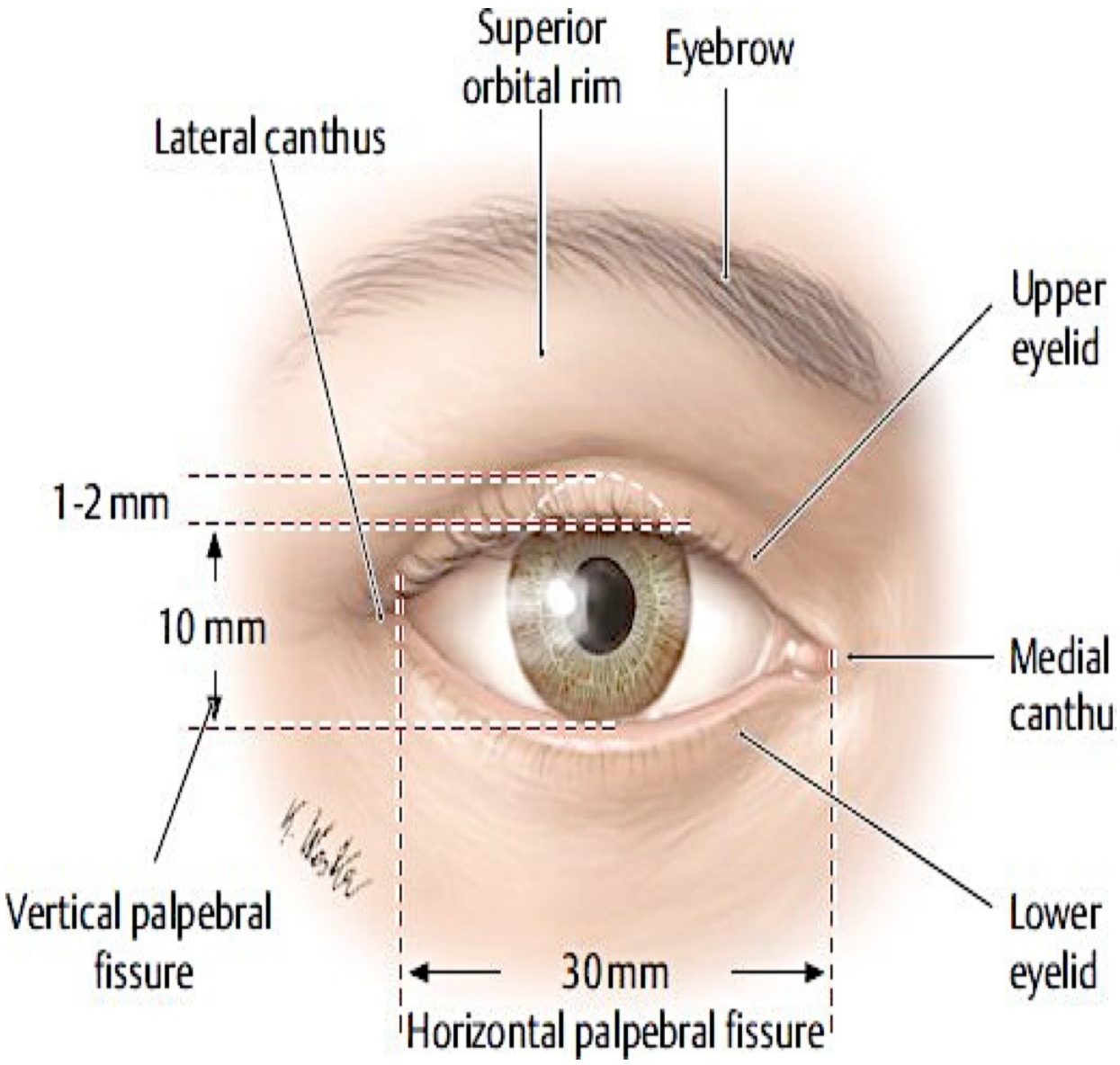
Eyelids

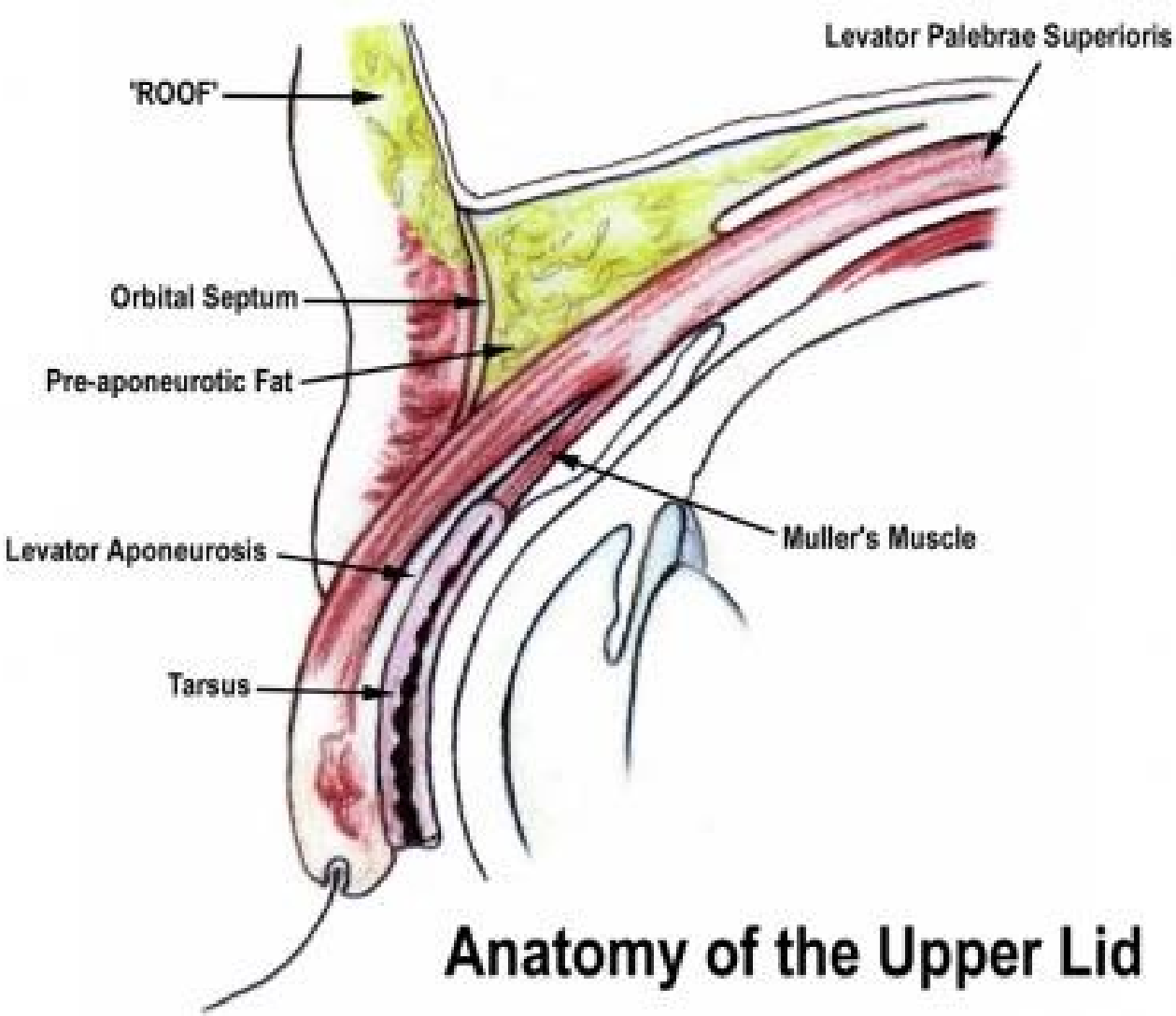
Orbicularis oculi
7th Cranial Nerve



Levator palpebrae superioris
3rd Cranial Nerve

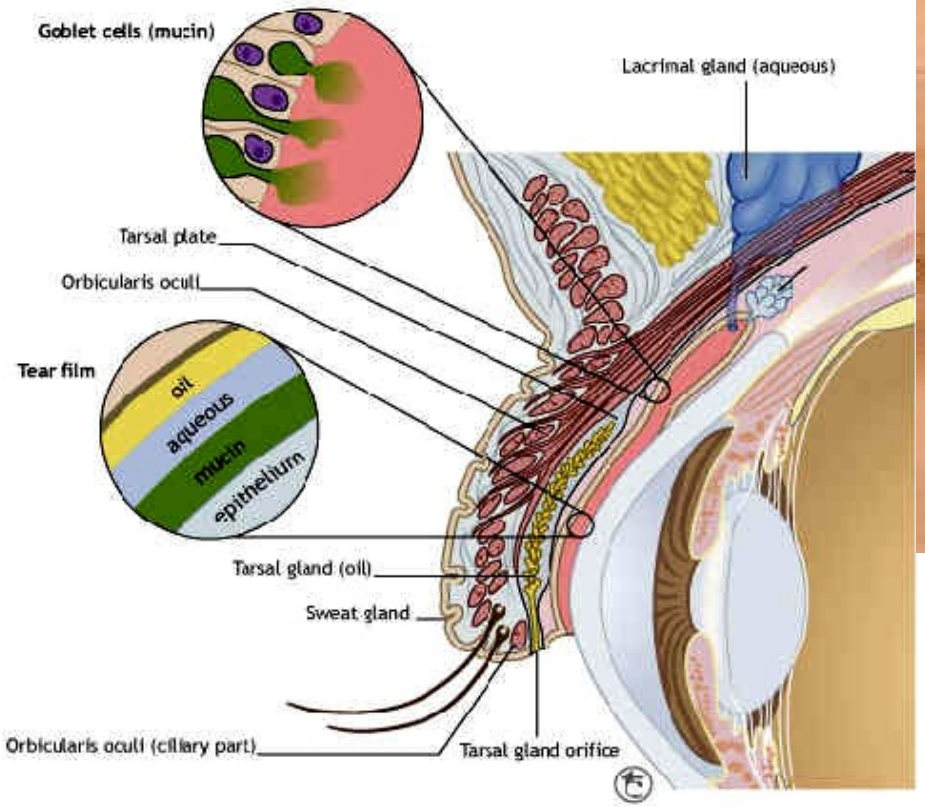


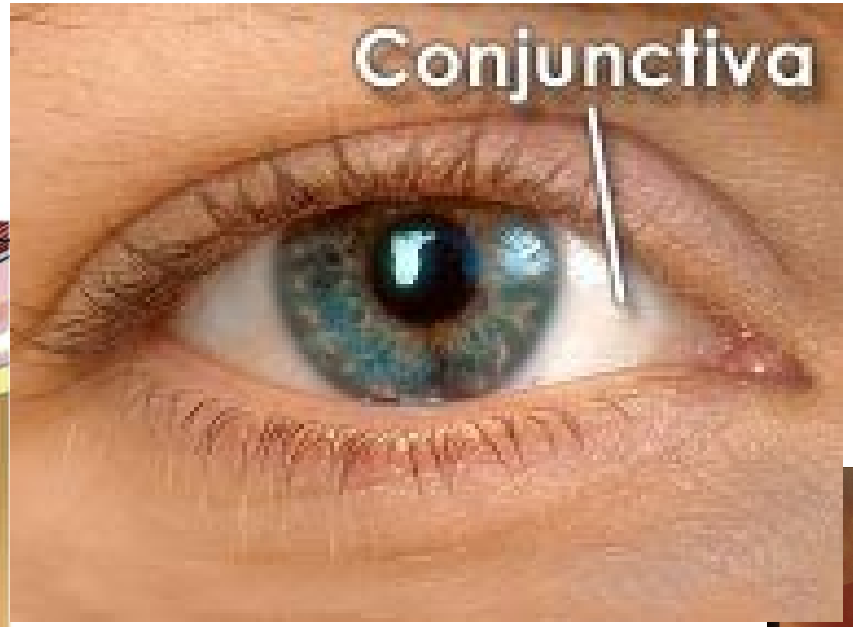




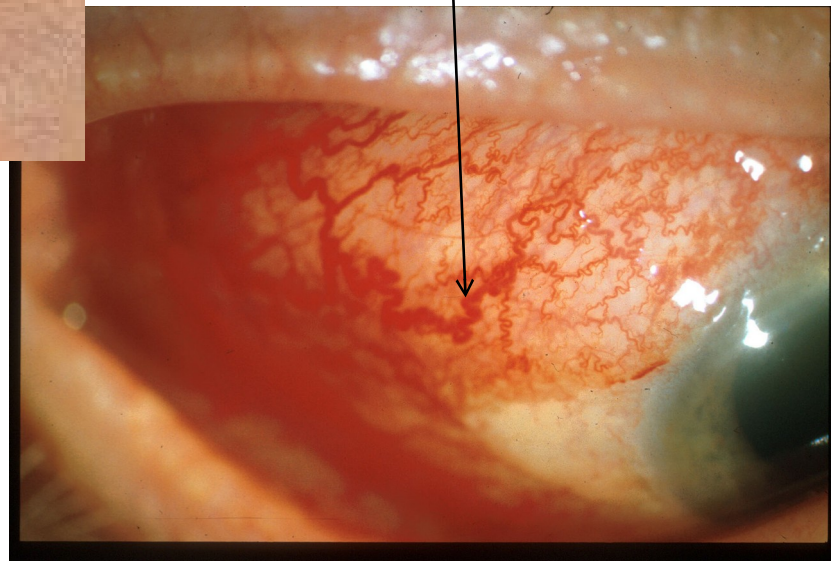
Anatomy of the Upper Lid

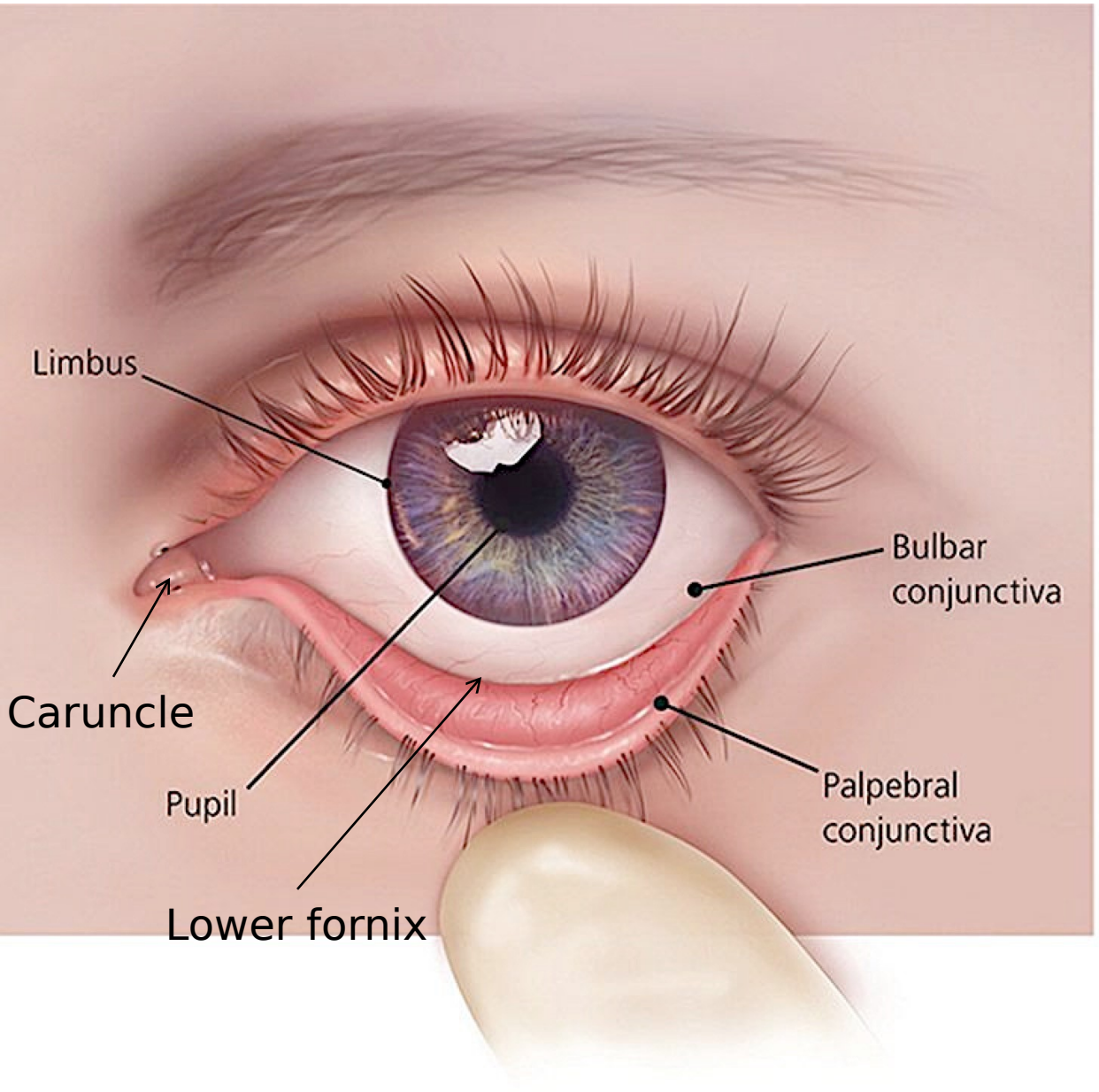
Conjunctiva

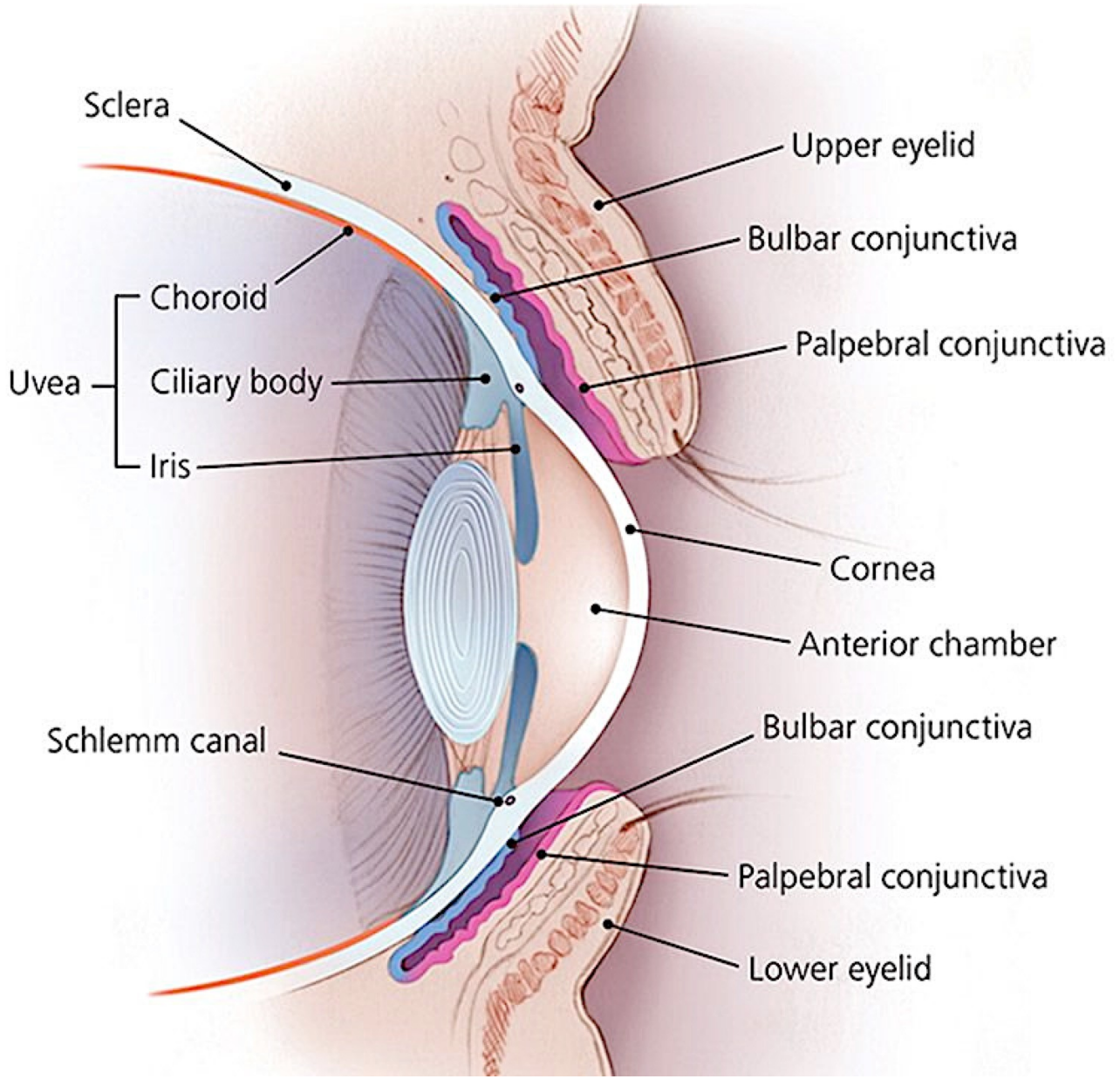




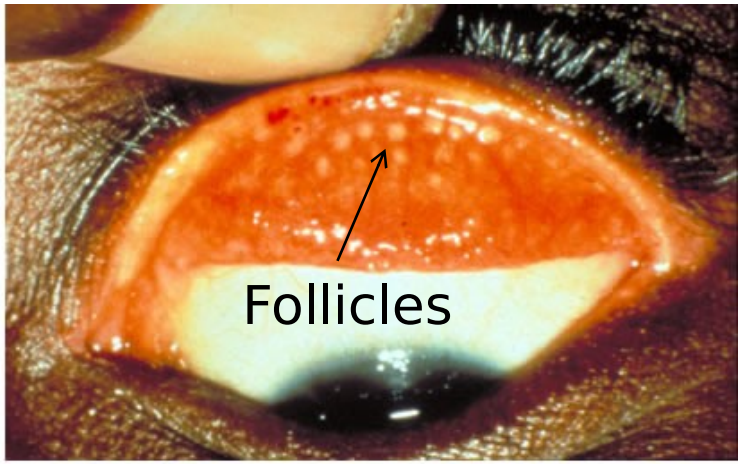
Inflamed conjunctiva

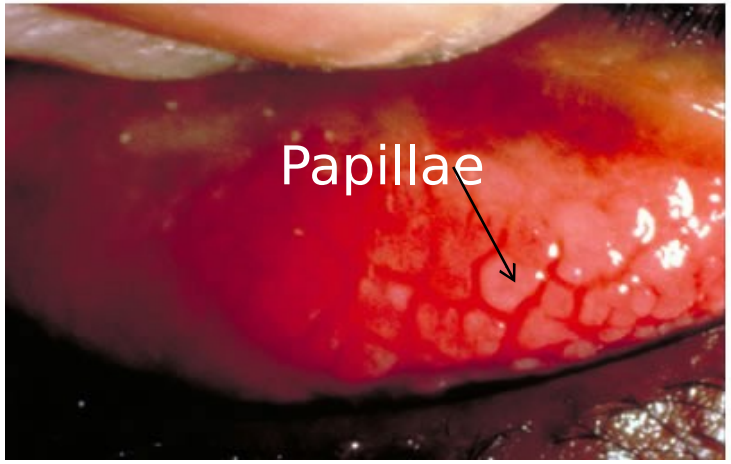


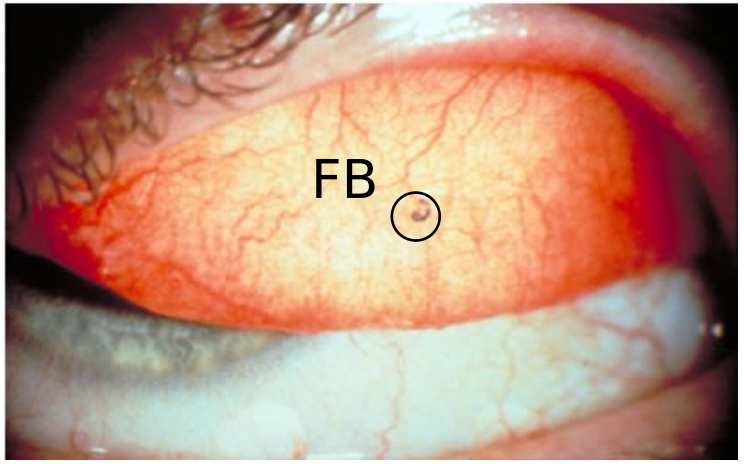

Limbus
Bulbar conjunctiva
Caruncle
Pupil
Palpebral conjunctiva
Lower fornix


Sclera
Upper eyelid
Bulbar conjunctiva
Choroid
Uvea
Ciliary body
Palpebral conjunctiva
Iris
Cornea
Anterior chamber
Schlemm canal
Bulbar conjunctiva
Palpebral conjunctiva
Lower eyelid

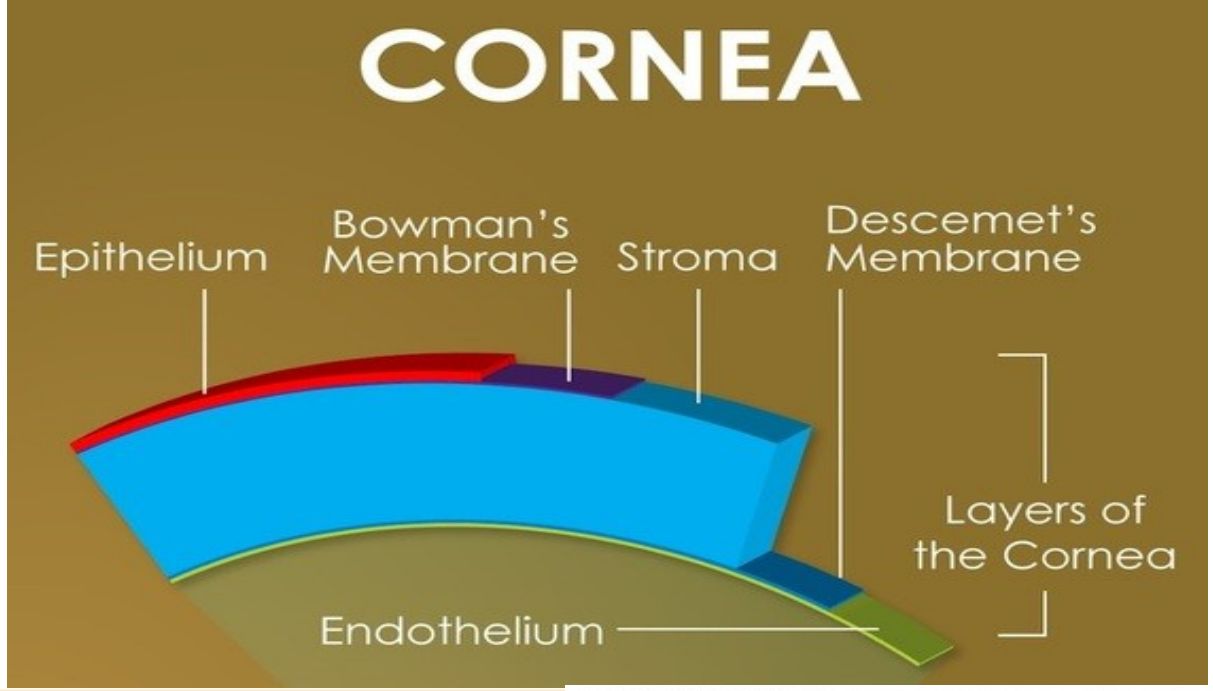
Palpebral Conjunctiva

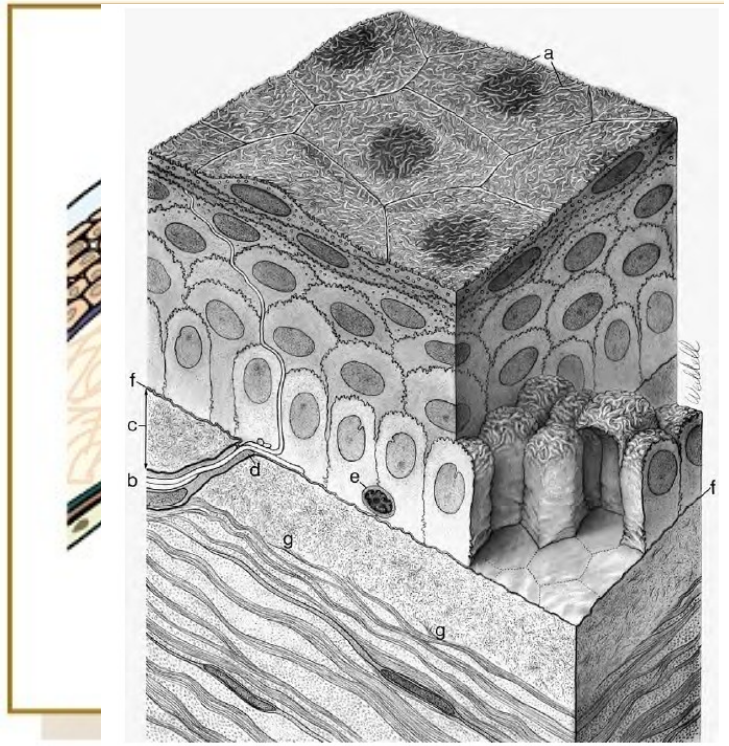


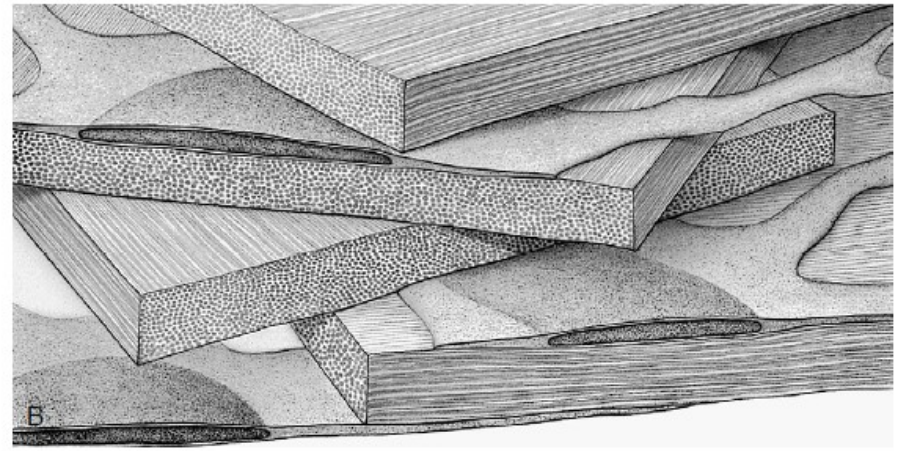




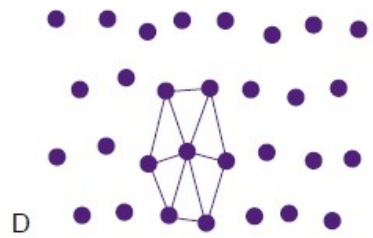
Everted Upper Lid


CORNEA
Epithelium
Bowman's Membrane
Stroma
Descemet's Membrane
Layers of the Cornea
Endothelium


a
f
c
b
d
e
g
g
f


B


C


D

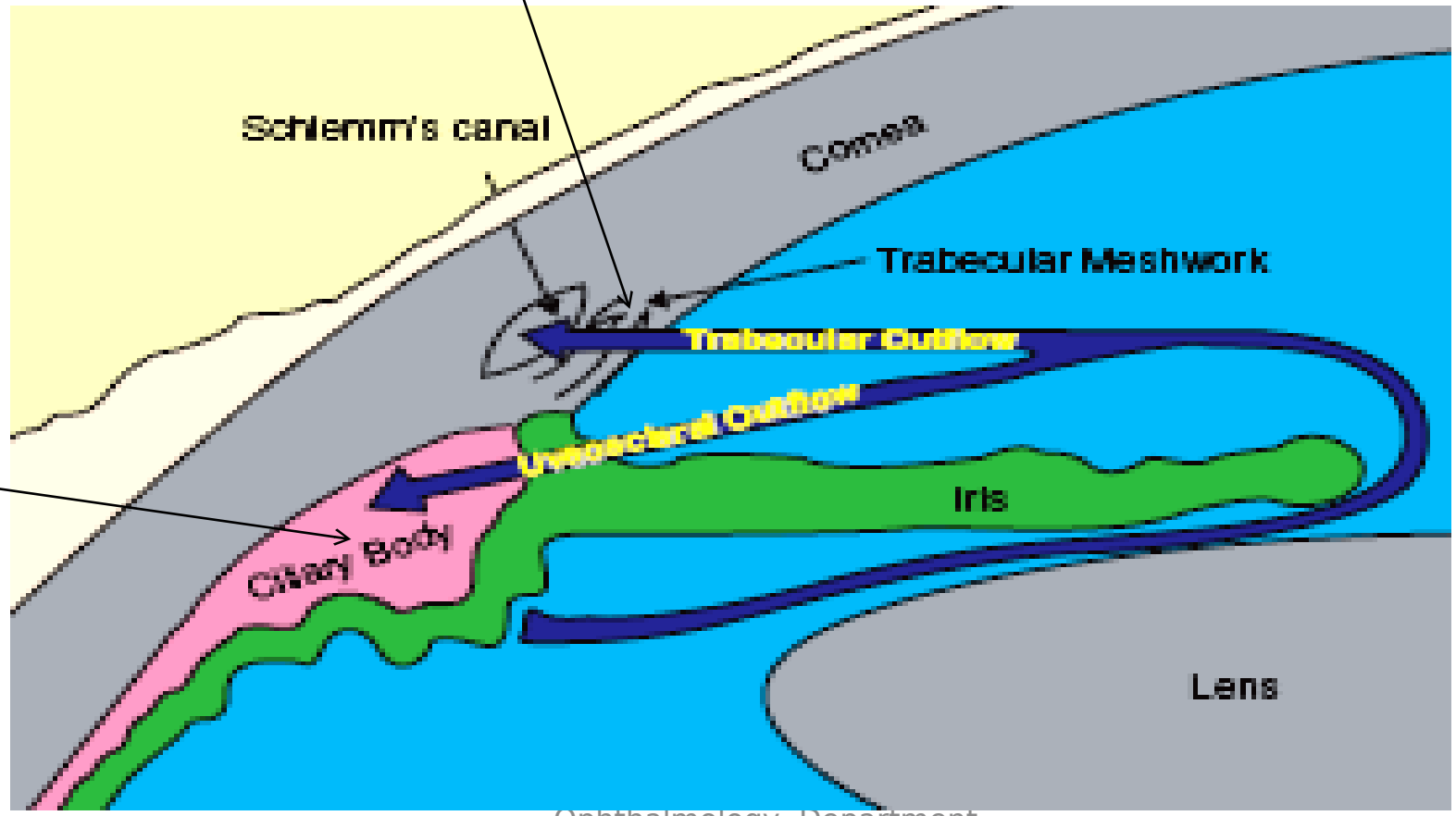
Endothelial layer

- Born with approx 4200 cells/mm^2
- Cells have a pump mechanism for removing fluid from the cornea
- No ability to replicate
- Cell death throughout life
- Cells are easily injured
- Normal adult count 2800 c/mm^2
- Gross corneal edema with vision change if <800 cells/mm^2

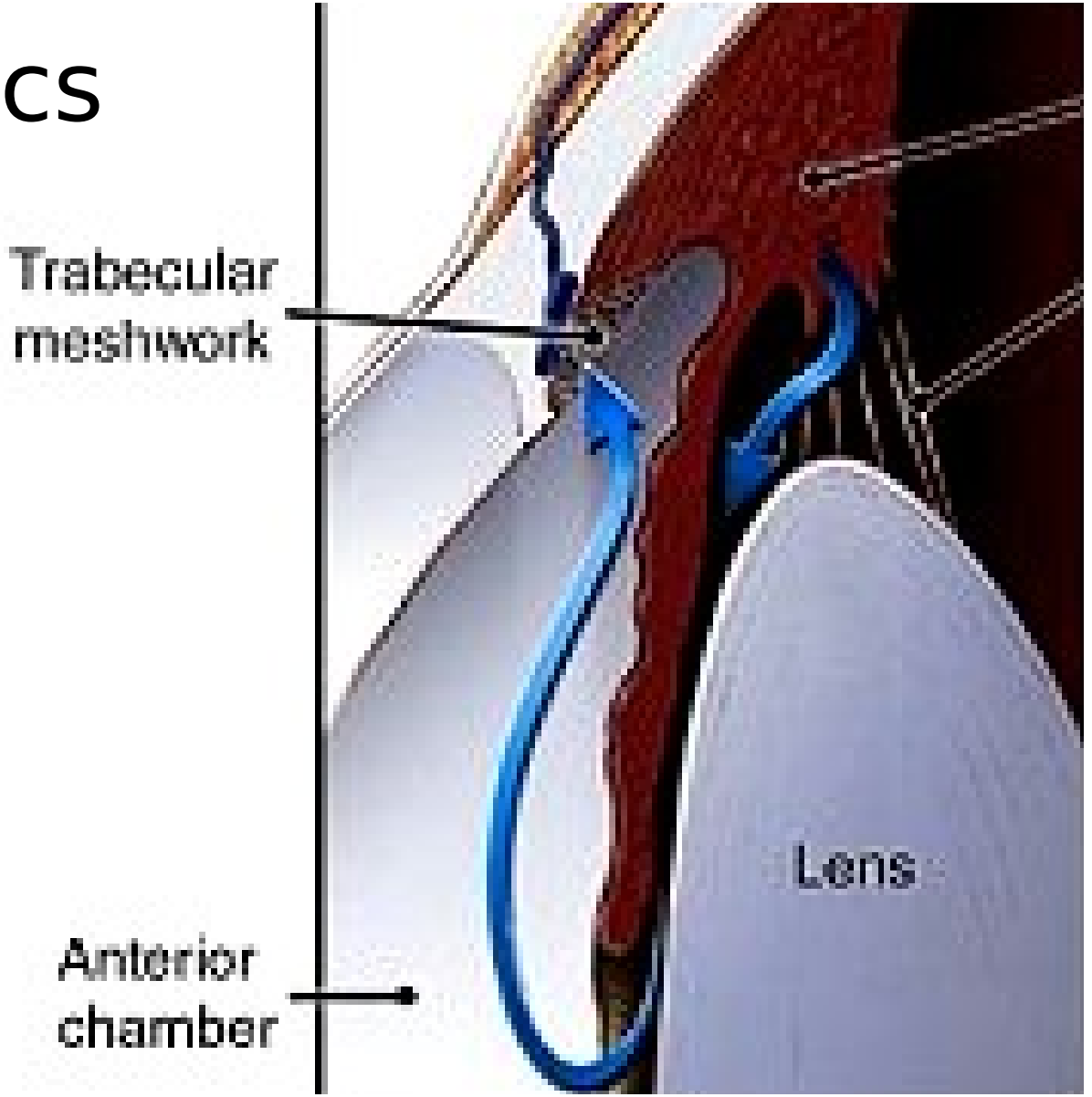
Aqueous Circulation

Trabecular outflow; 65-75%

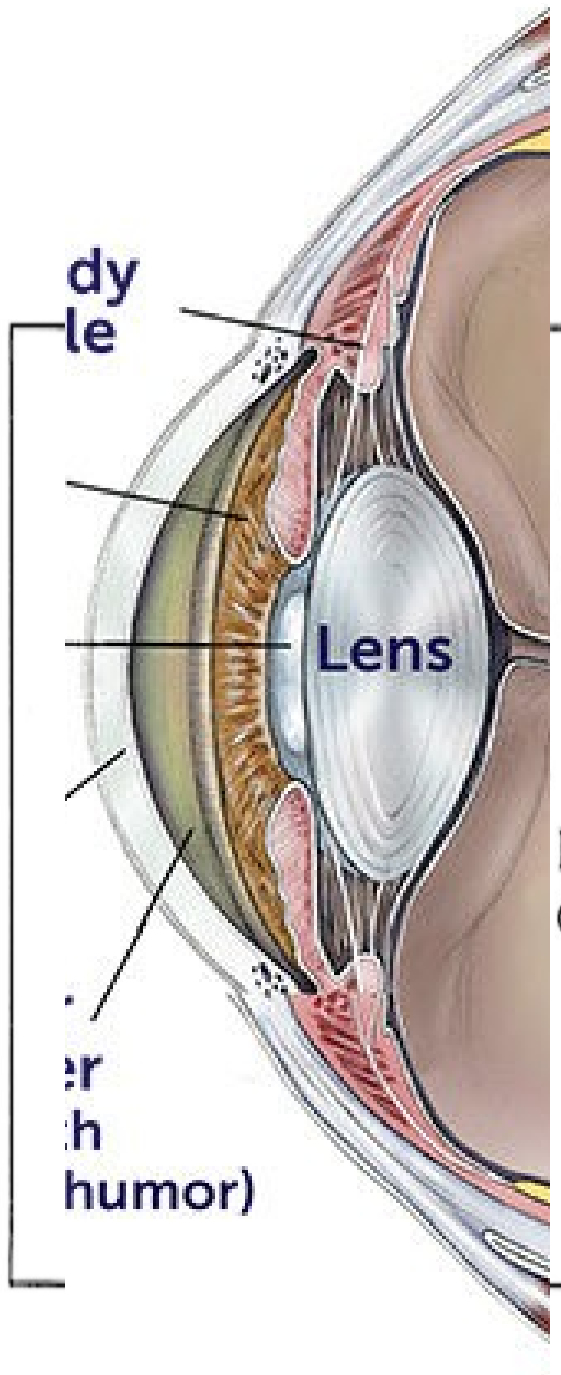
Secretion

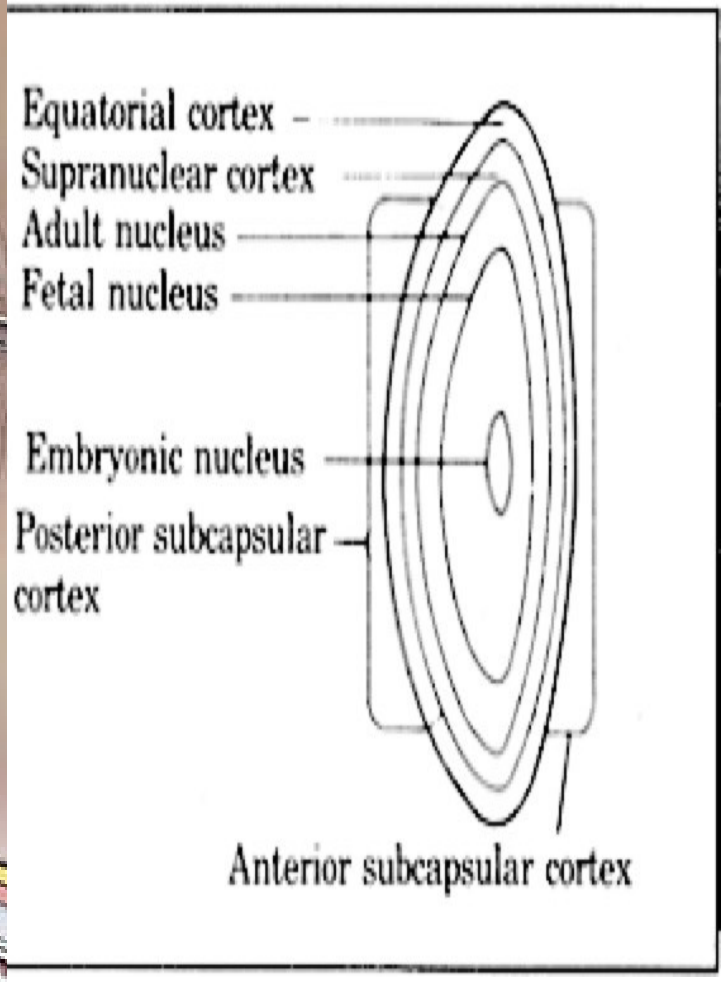


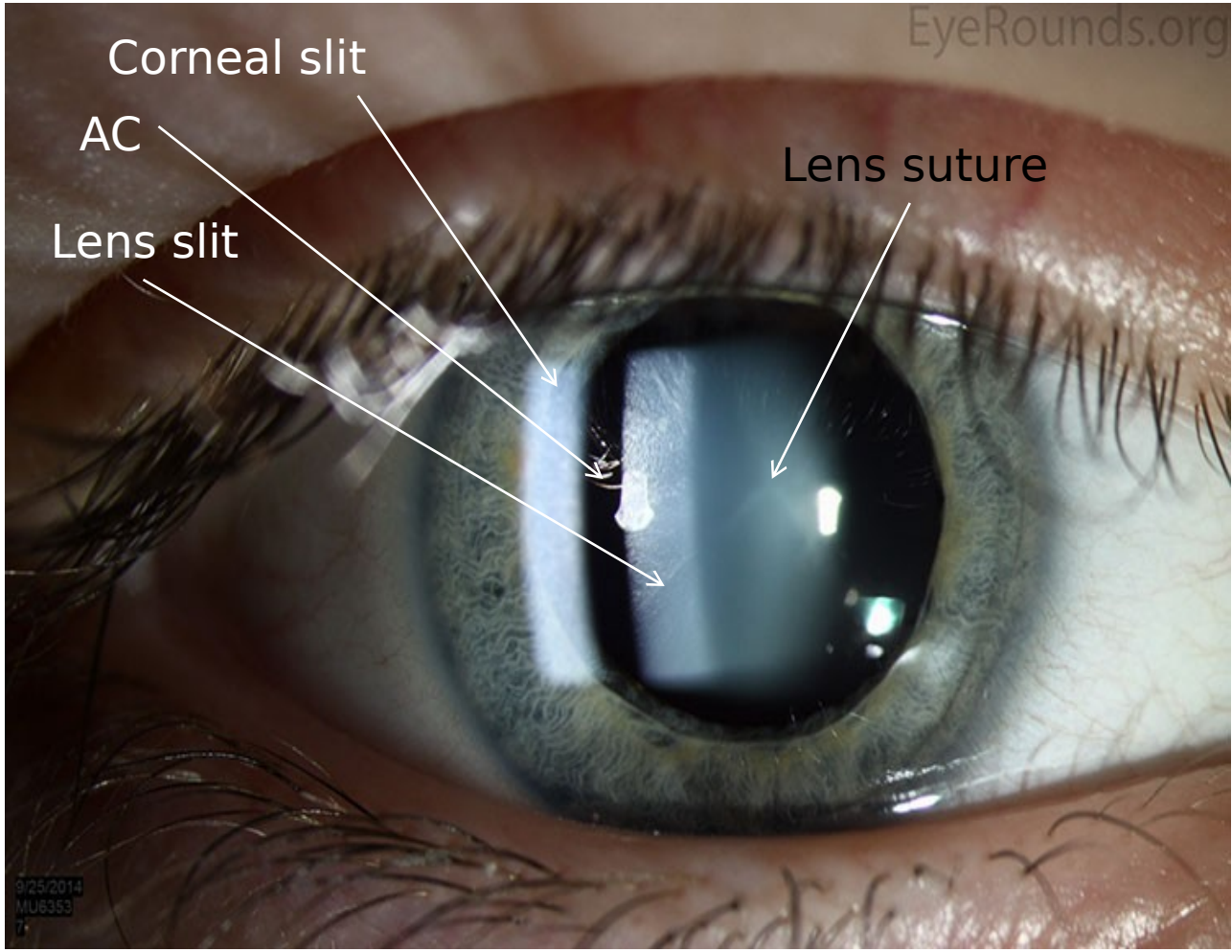
Aqueous Dynamics

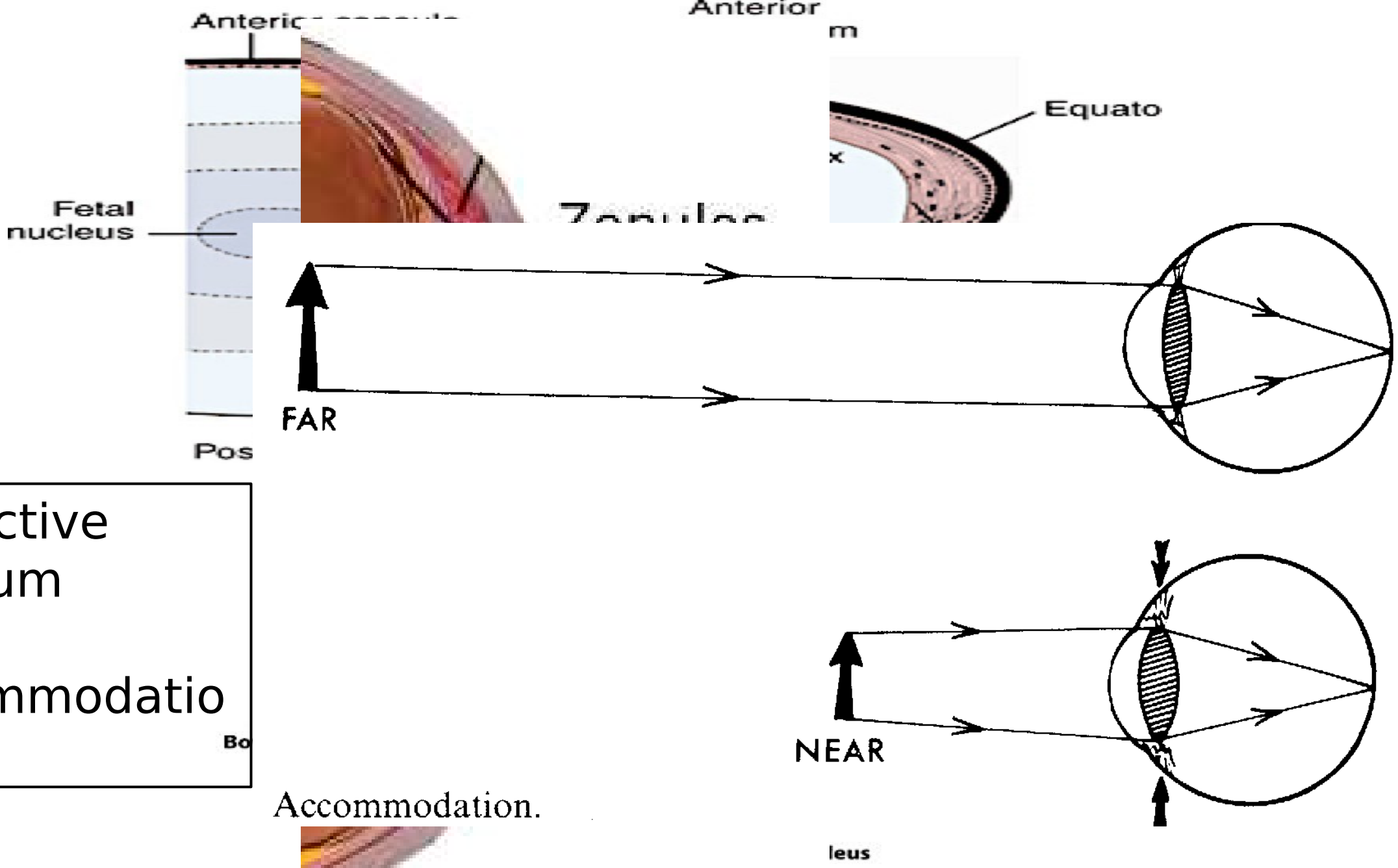


The Crystalline Lens





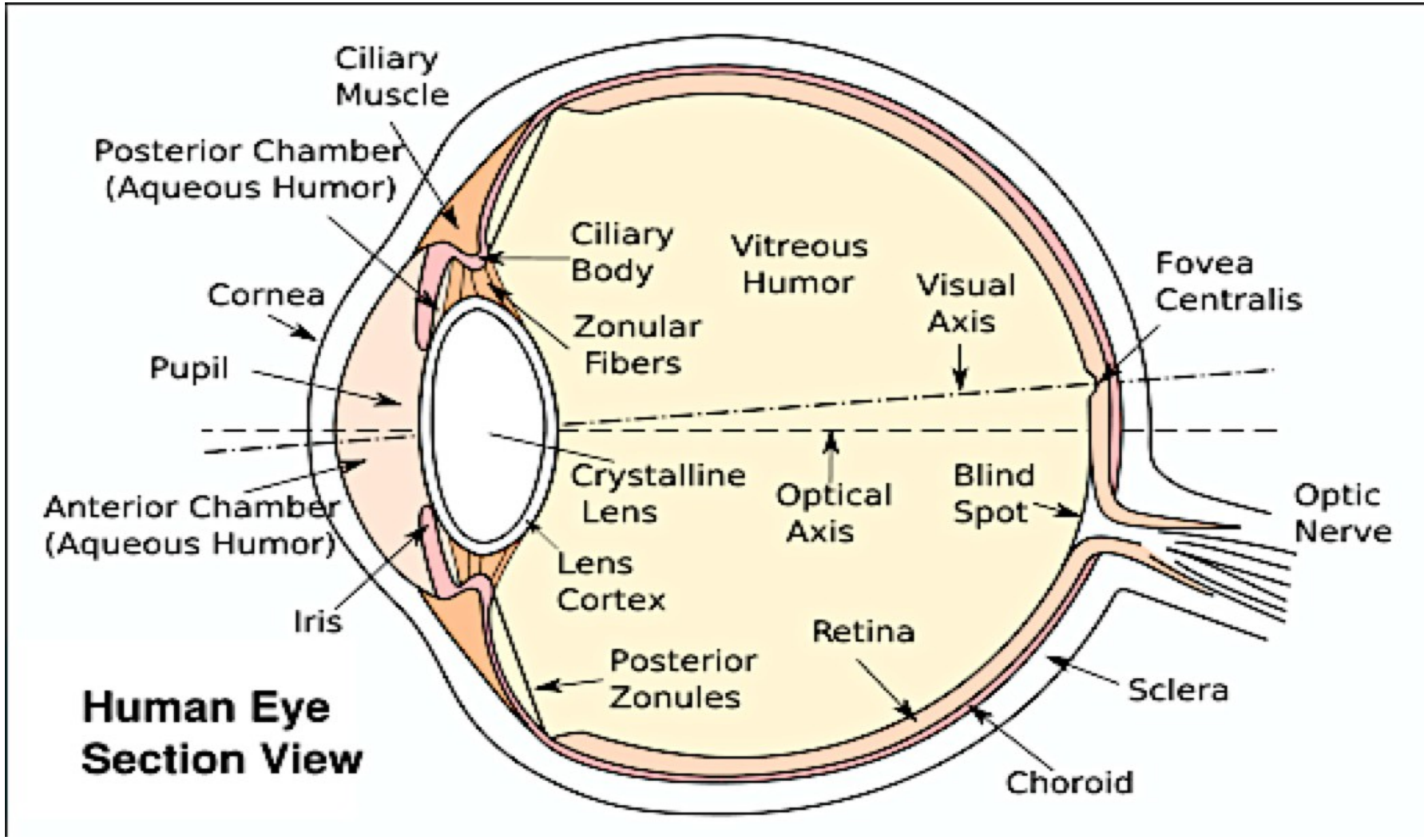


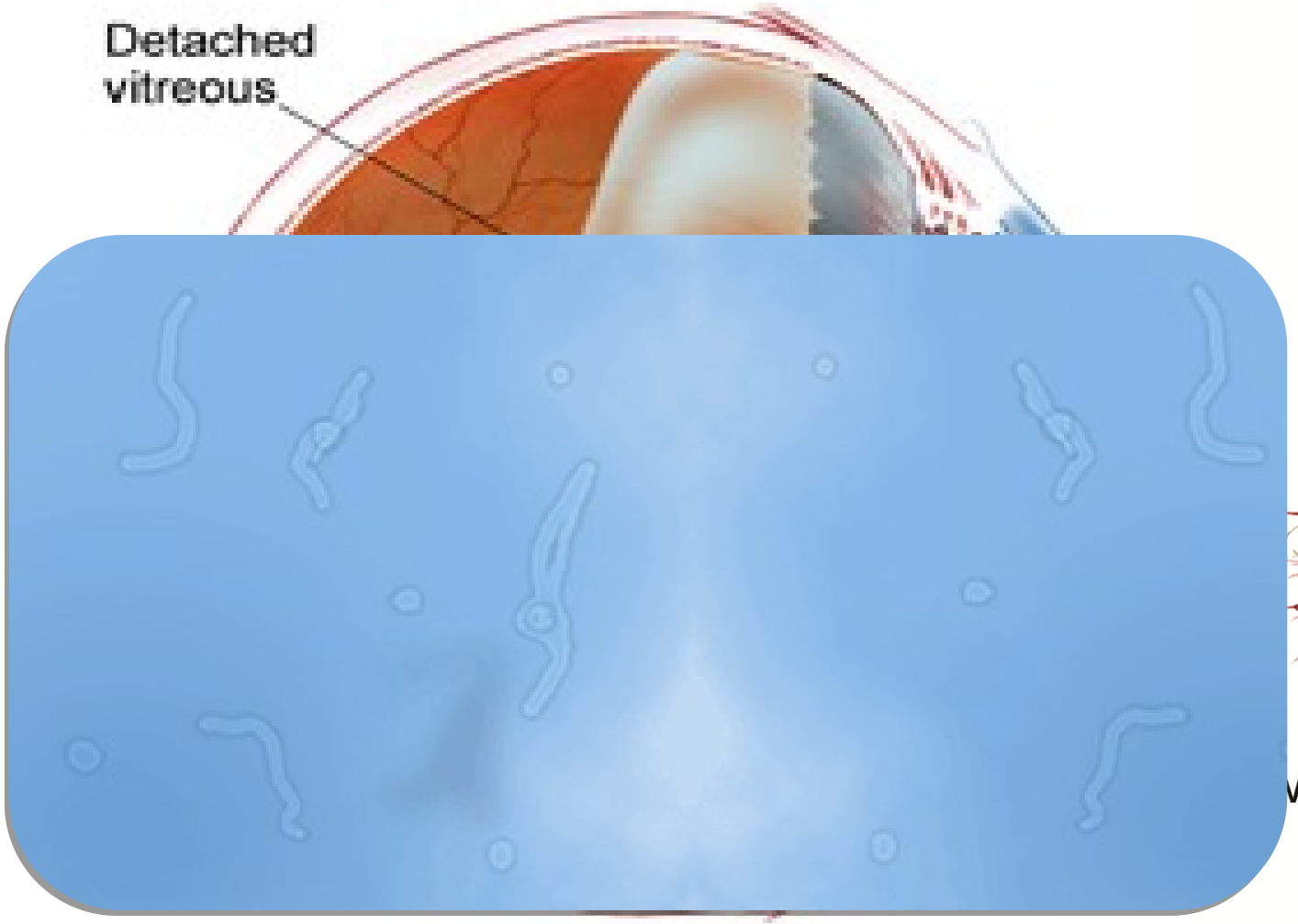


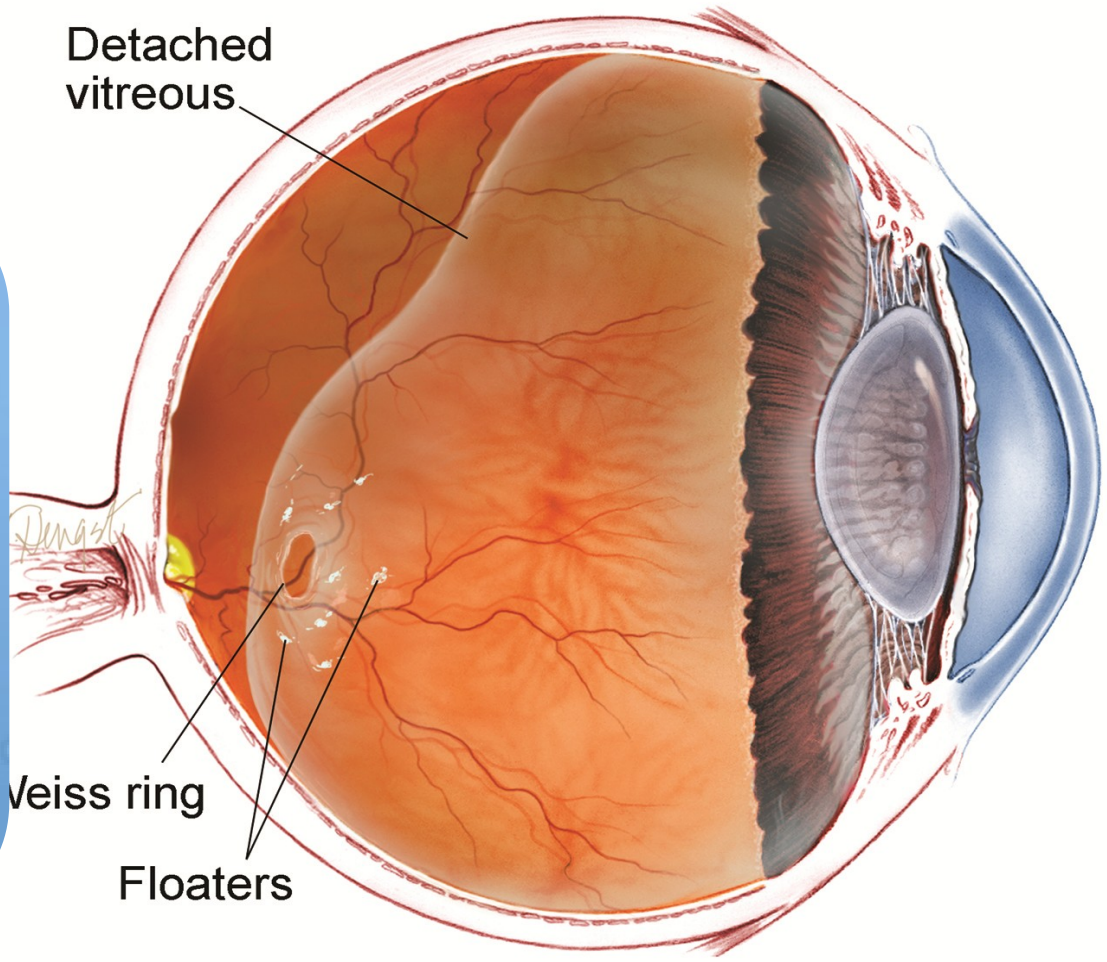
Refractive medium

Accommodation

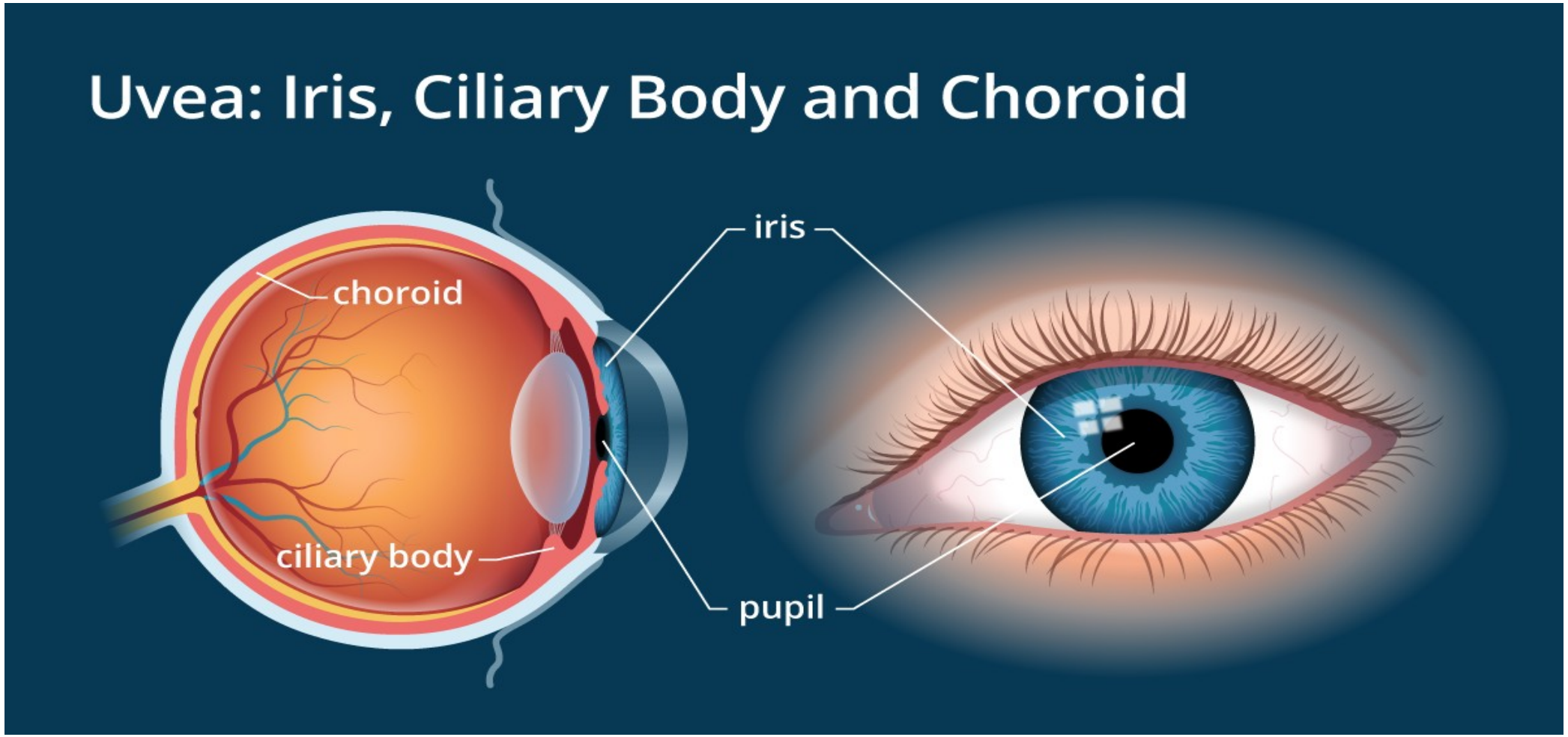
The Vitreous



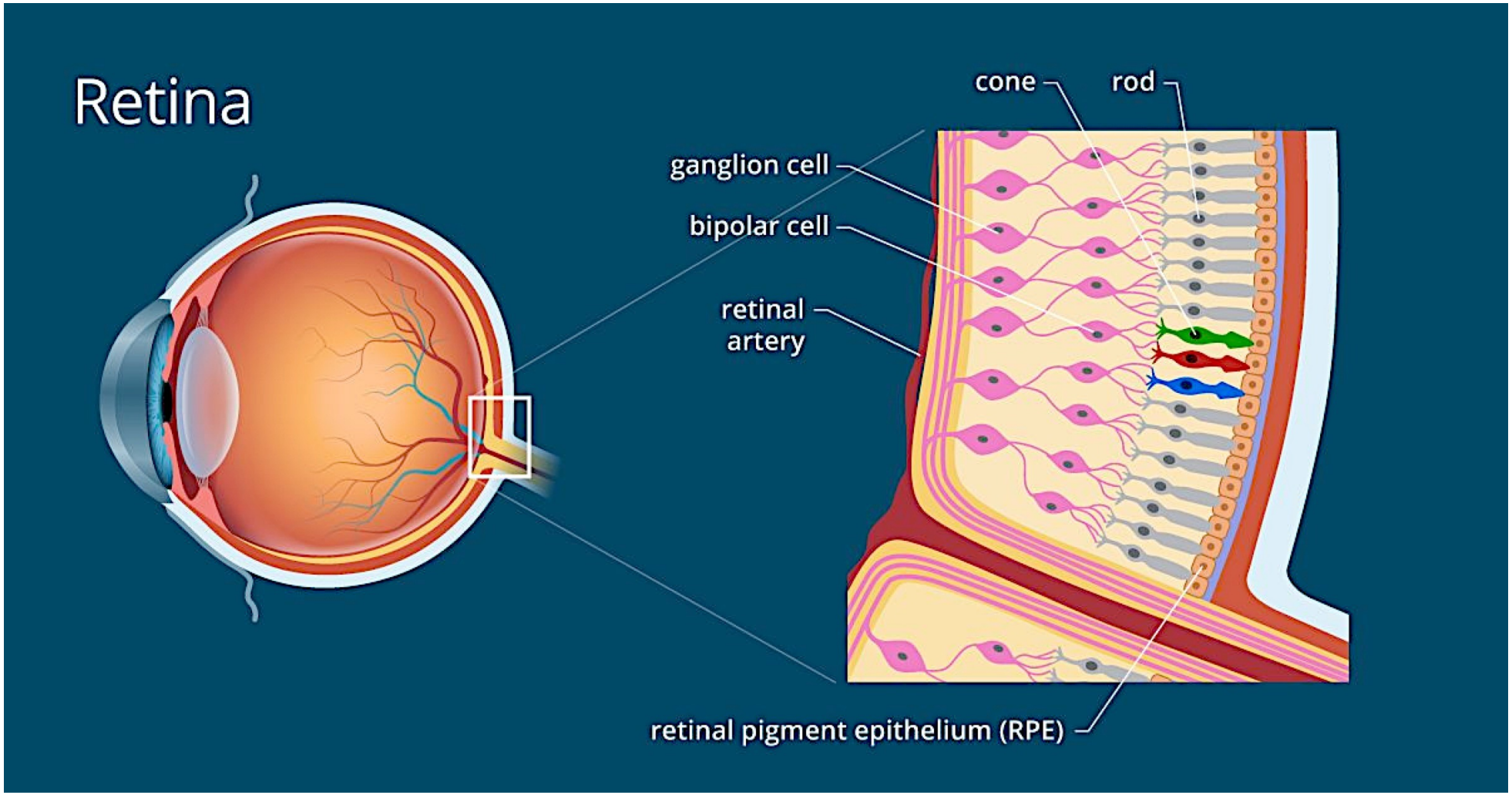

Detached
vitreous


Detached
vitreous
Weiss ring
Floaters

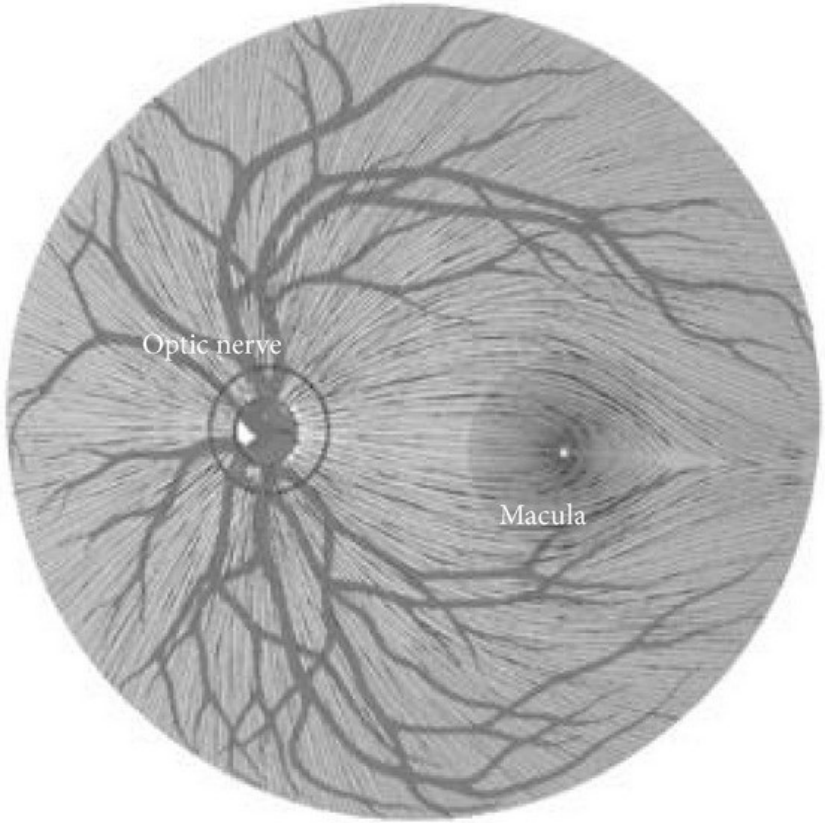
The Uvea

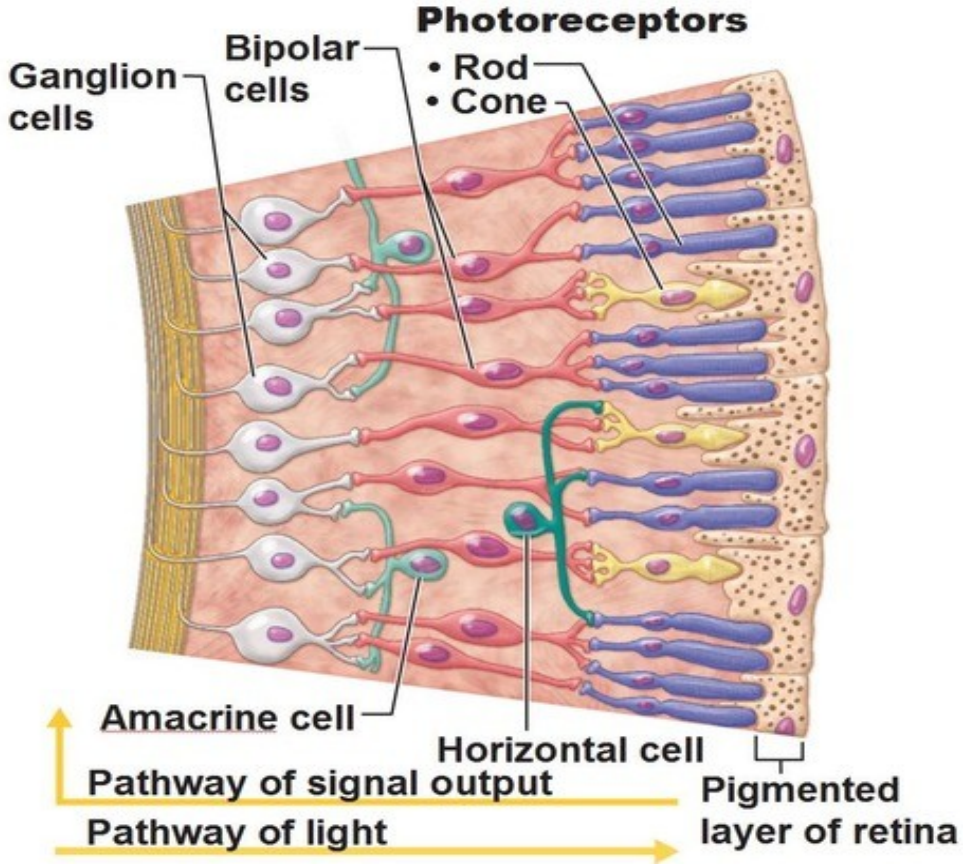

Uvea: Iris, Ciliary Body and Choroid
choroid
ciliary body
iris
pupil

The Retina

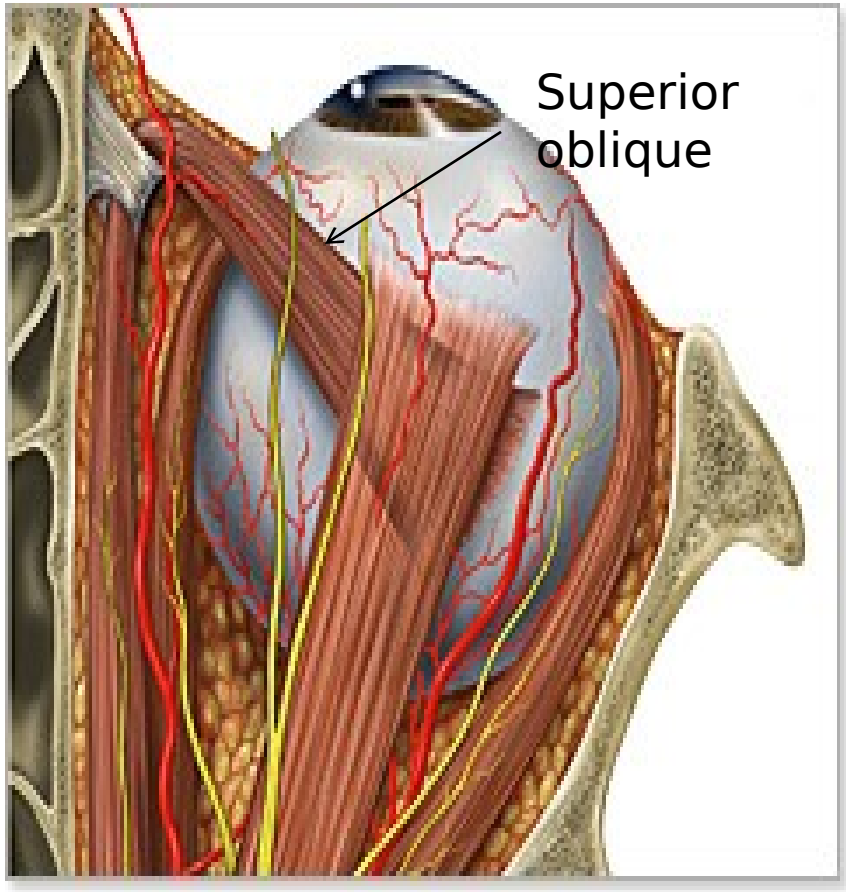

Retina
cone
rod
ganglion cell
bipolar cell
retinal artery
retinal pigment epithelium (RPE)

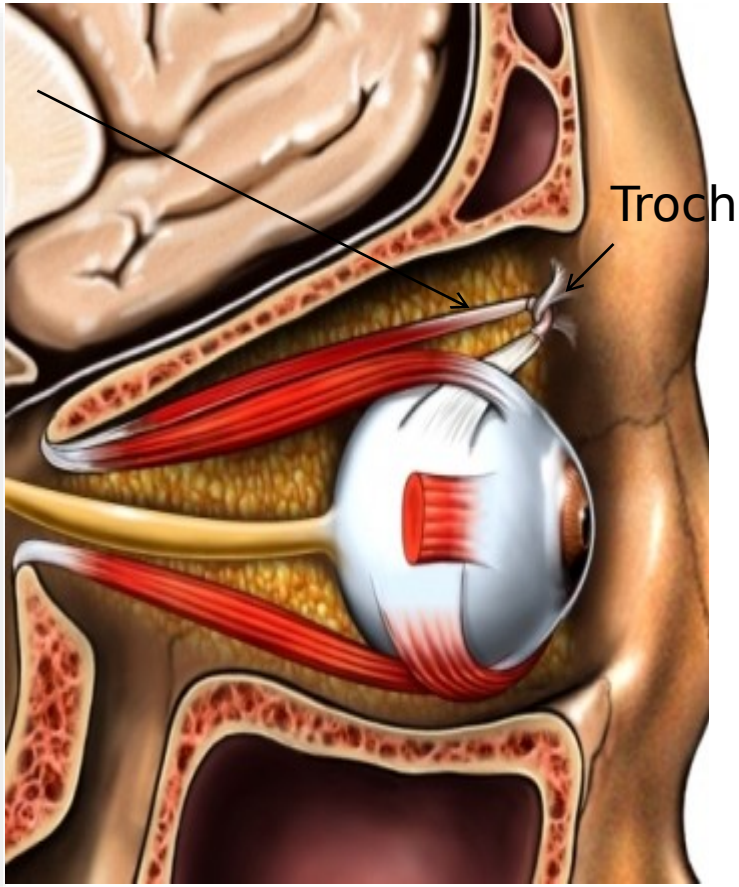
The Retina

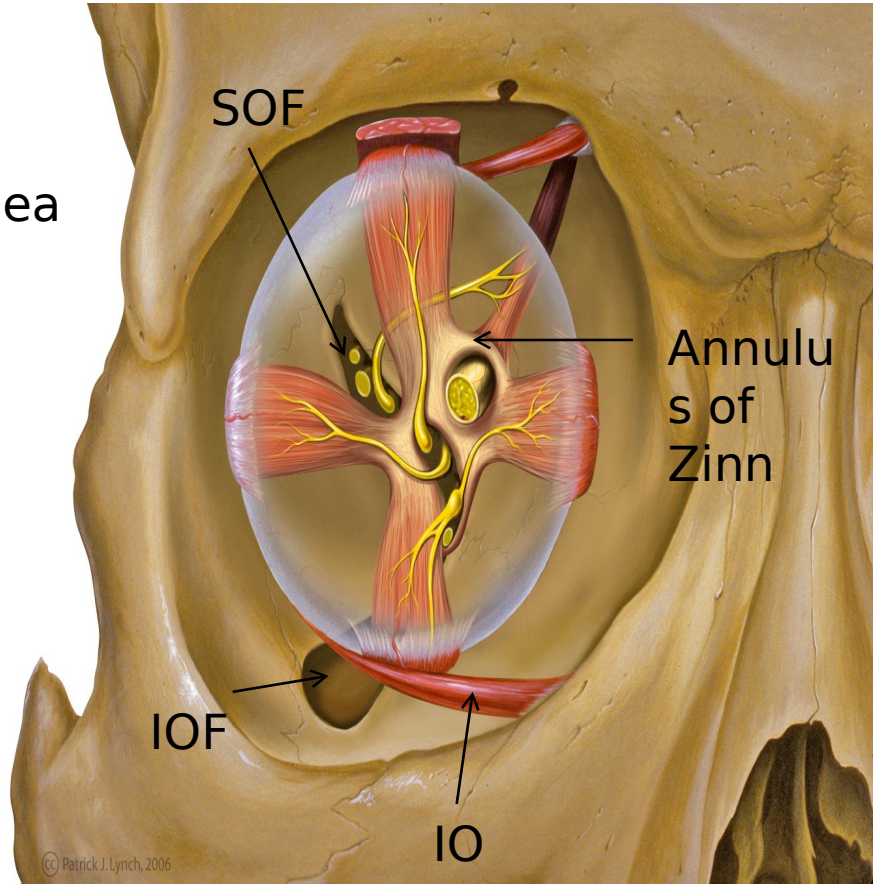

Optic nerve
Macula


Photoreceptors
Ganglion cells
Bipolar cells
• Rod
• Cone
Amacrine cell
Horizontal cell
Pathway of signal output
Pathway of light
Pigmented layer of retina

Extraocular Muscles

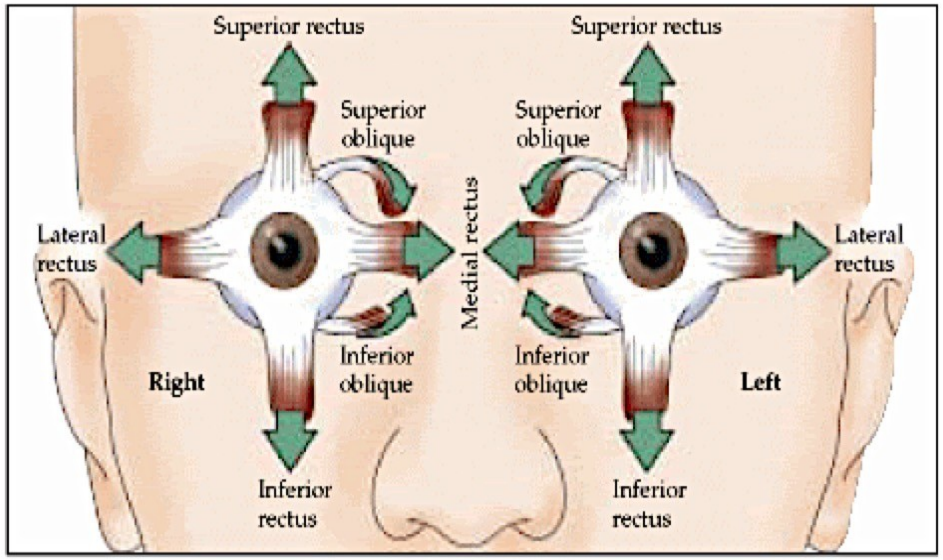


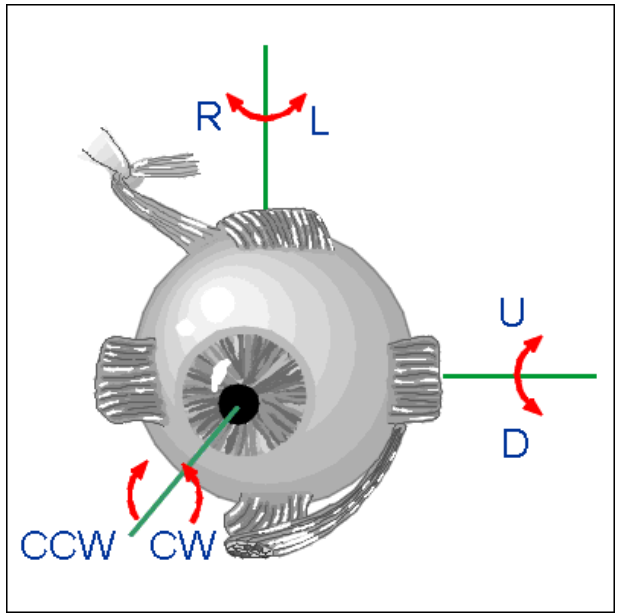




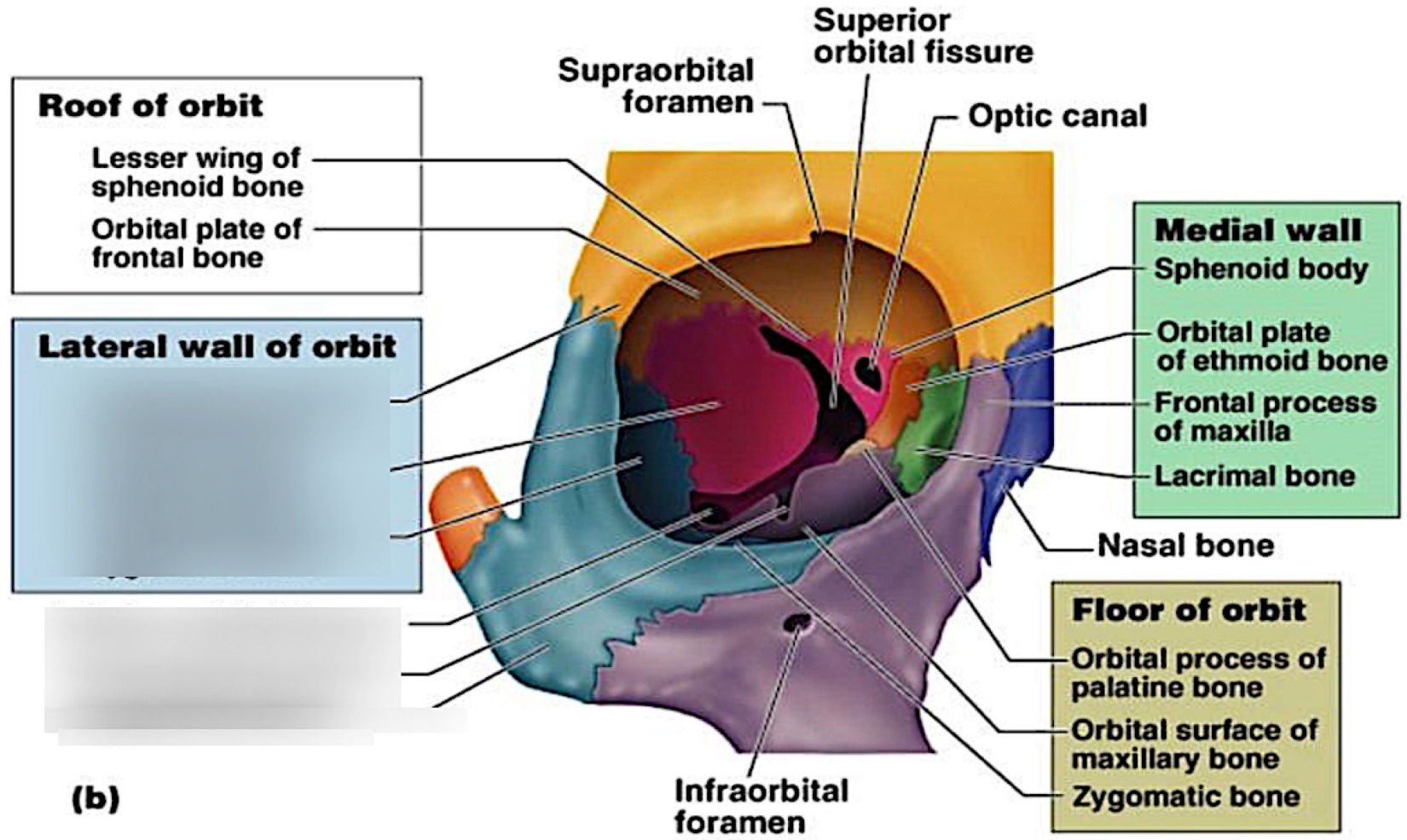
Extraocular Muscles

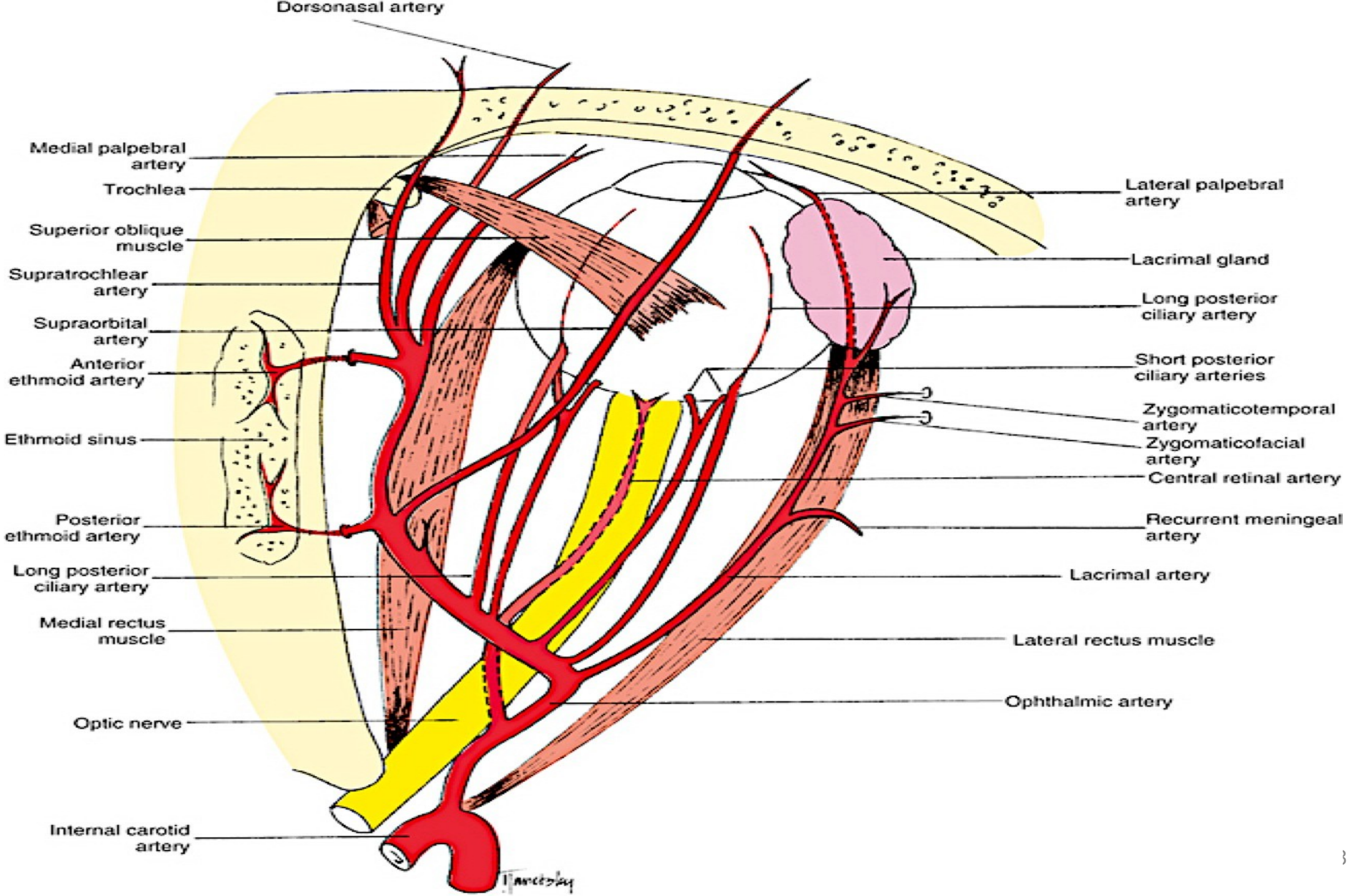
- 6 muscles; 4 recti and 2 obliques
- The primary actions of the recti are: abduction (LR), adduction (MR), elevation (SR) and depression (IR)
- The primary actions of the obliques are: intorsion (SO) and extorsion (IO)





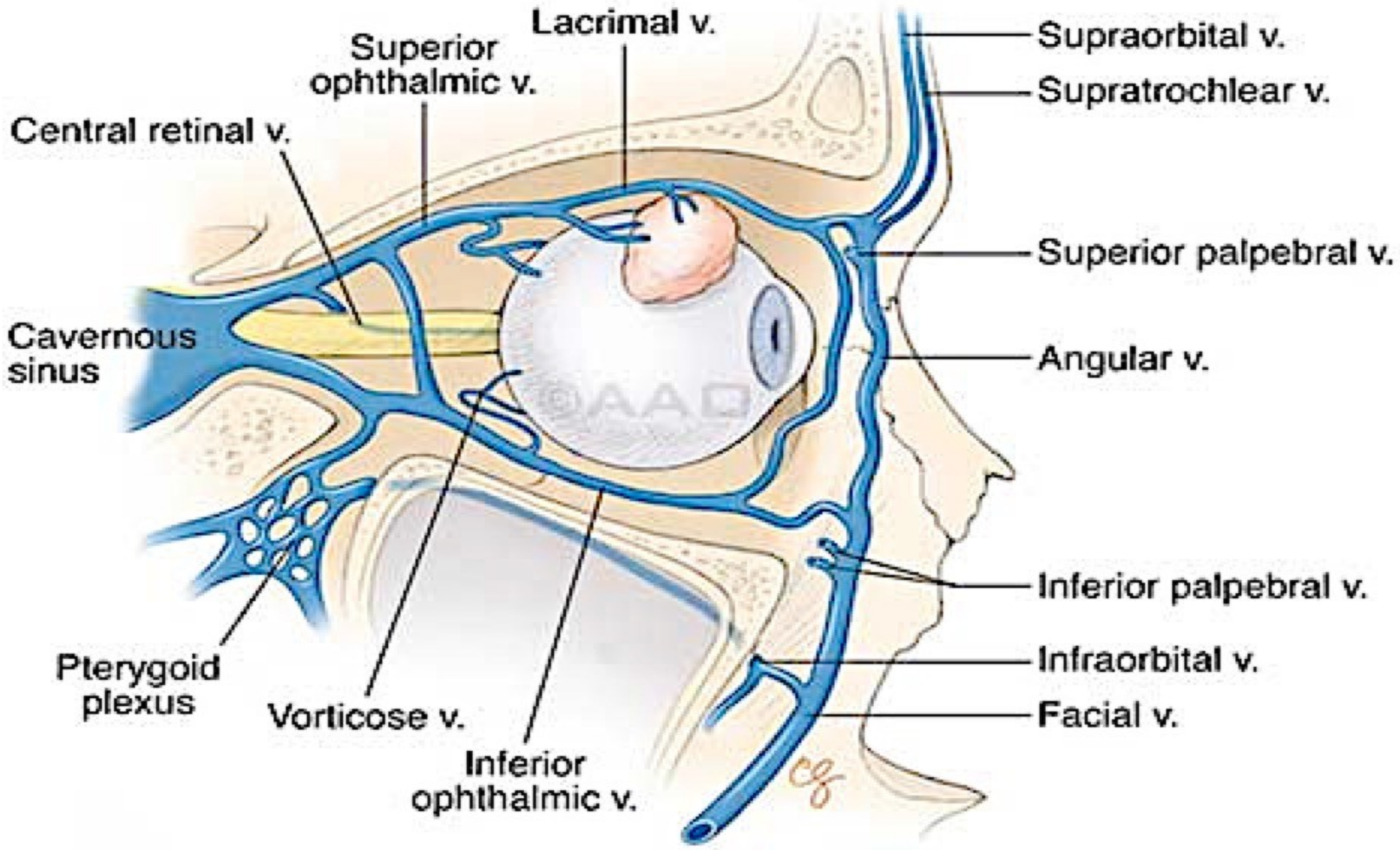
The Bony Orbit



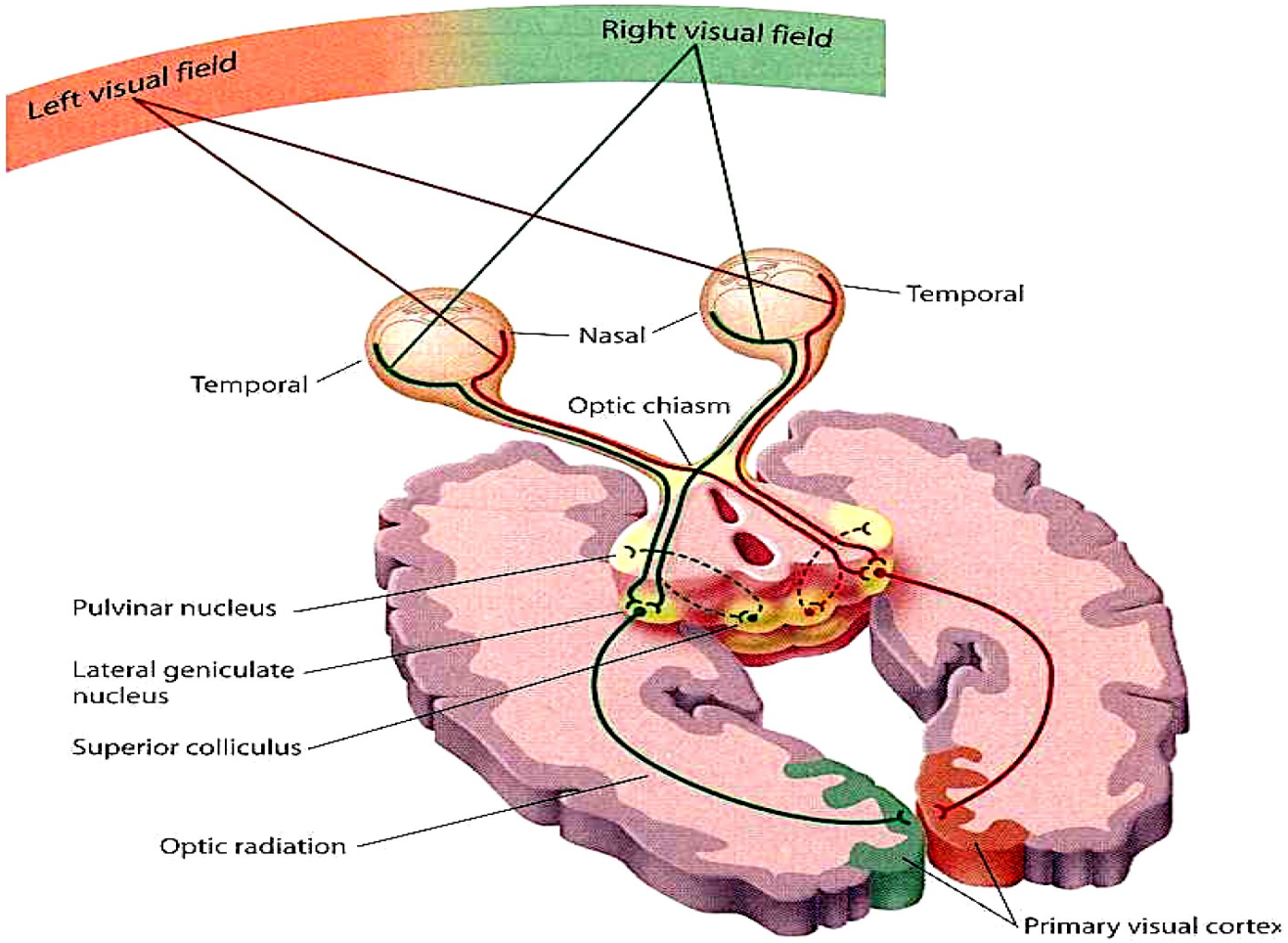

Dorsonasal artery
Medial palpebral artery
Trochlea
Superior oblique muscle
Supratrochlear artery
Supraorbital artery
Anterior ethmoid artery
Ethmoid sinus
Posterior ethmoid artery
Long posterior ciliary artery
Medial rectus muscle
Optic nerve
Internal carotid artery
Lateral palpebral artery
Lacrimal gland
Long posterior ciliary artery
Short posterior ciliary arteries
Zygomaticotemporal artery
Zygomaticofacial artery
Central retinal artery
Recurrent meningeal artery
Lacrimal artery
Lateral rectus muscle
Ophthalmic artery

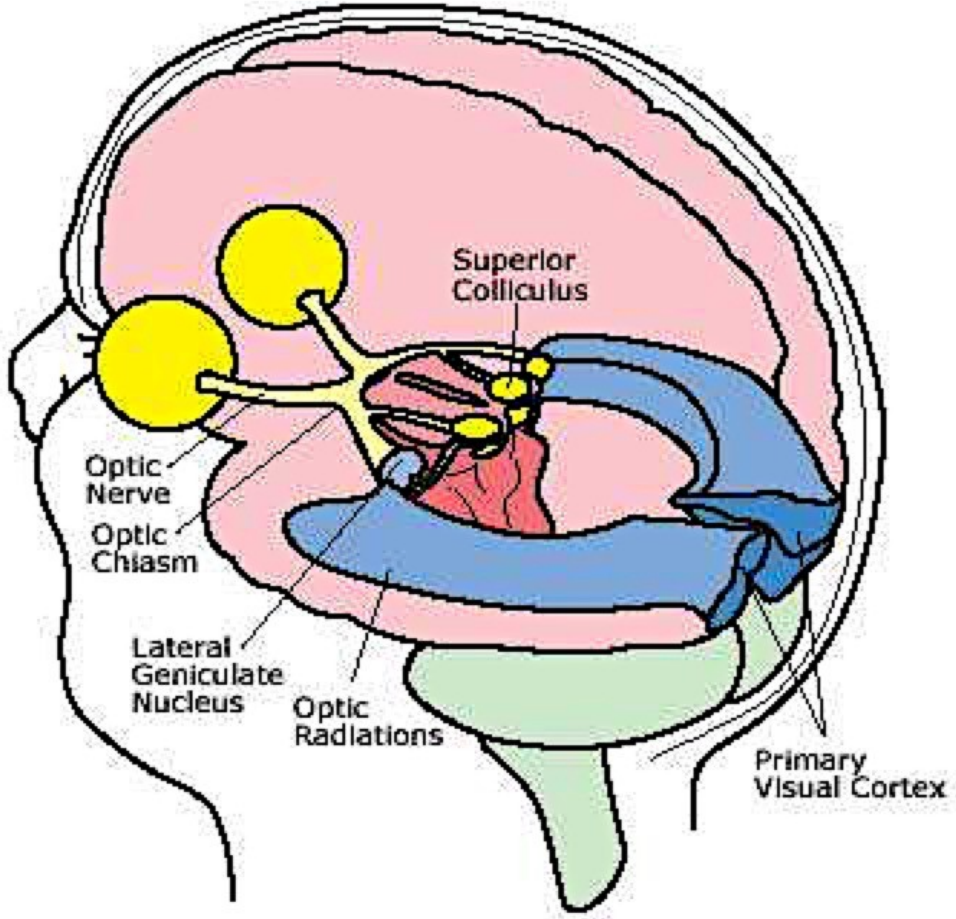
The Venous Drainage

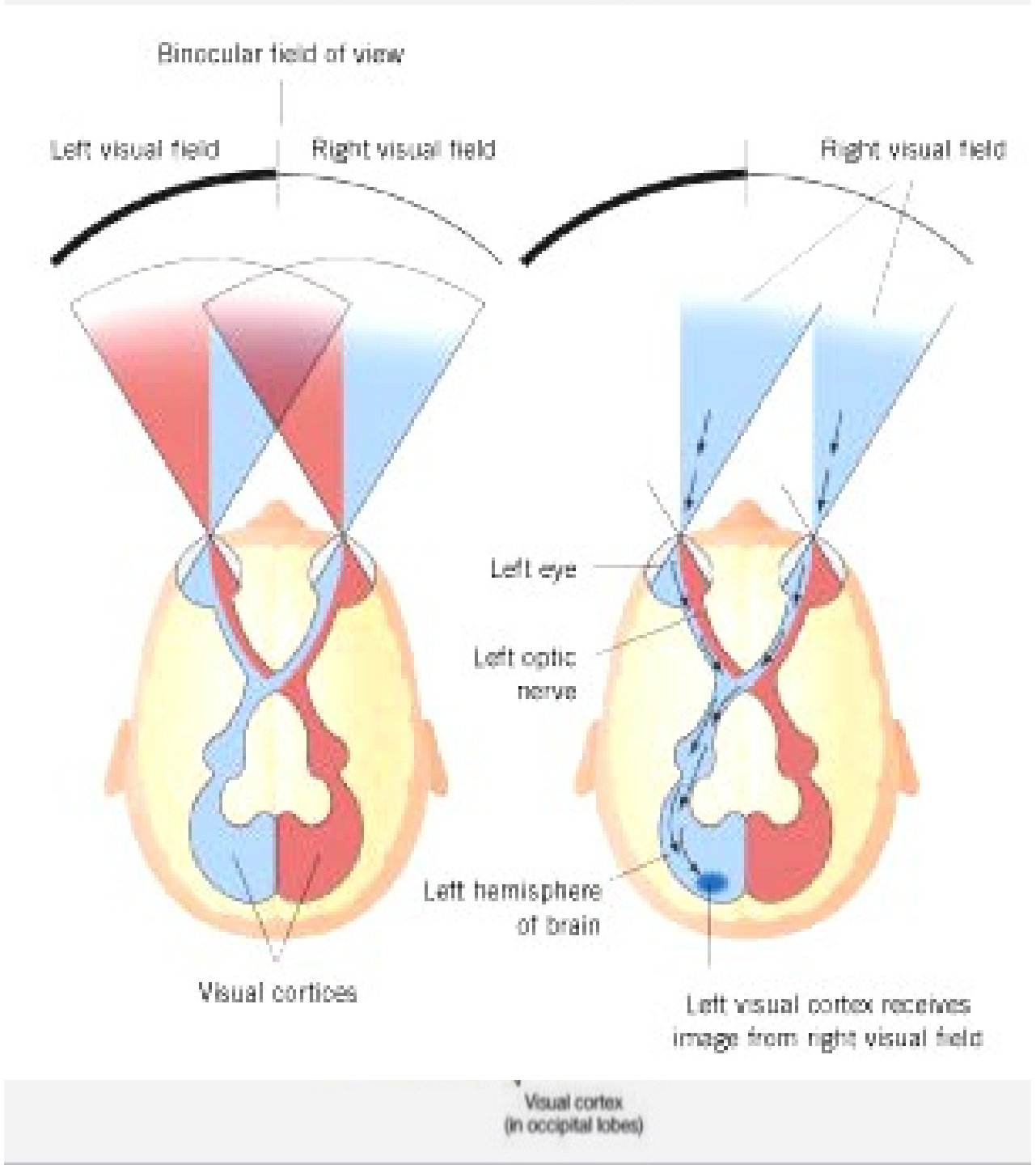
1



The Visual Pathway






Binocular field of view
Left visual field
Right visual field
Right visual field
Left eye
Left optic nerve
Left hemisphere of brain
Visual cortices
Left visual cortex receives image from right visual field
Visual cortex (in occipital lobes)

The Visual Pathway

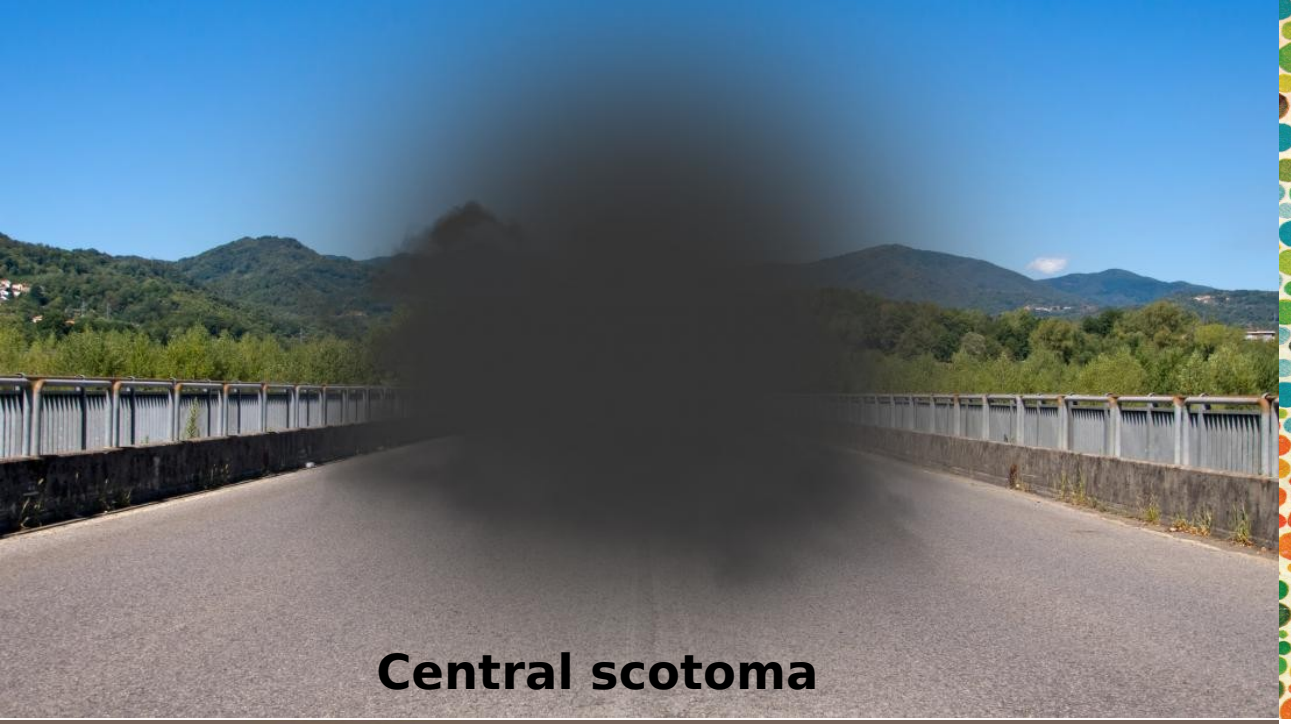
- The 2 optic nerves decussate in the **chiasm** with the **nasal** fibers crossing to the opposite side and the **temporal** fibers remaining on the same side as the optic tract
- The optic tract ends in the lateral geniculate nucleus
- New fibers arise from the lateral geniculate nucleus forming the optic radiation which ends in the visual cortex **around the calcarine fissure on the medial side of the occipital lobe**
- The upper fibers of the optic radiation, that serve the lower field, run in the parietal lobe while the lower fibers, that serve the upper field run in the temporal lobe

Basic Ocular Examination

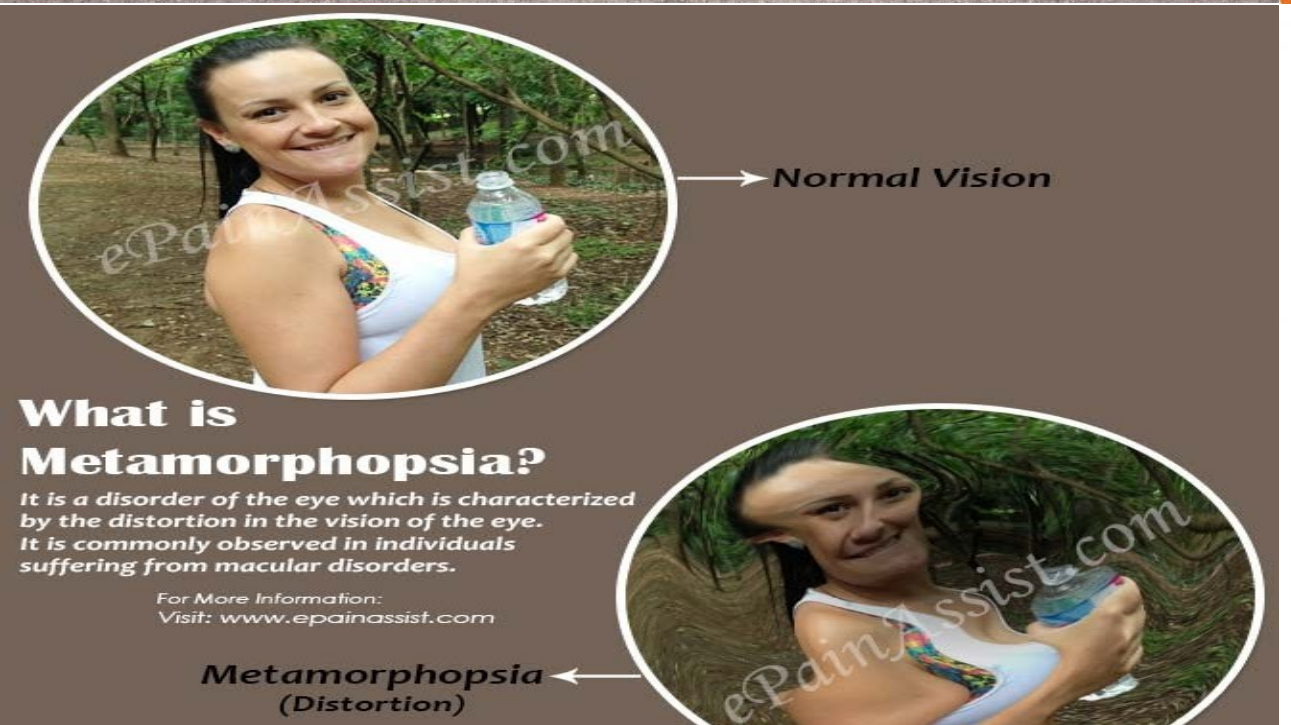
History Taking

By careful History-taking you can reach a provisional diagnosis in many cases.

- Presenting (Chief) Complaint : (in patient's own words)
  - Change in external appearance (ptosis , proptosis, squint)
  - Red eye: Pain , headache, discharge, FB sensation, and photophobia
  - Visual Complaints (Drop of vision; sudden, acute, gradual)
  - Miscellaneous: metamorphosia, foggy vision, floaters, flashes, diplopia, scotoma, epiphora…etc.)
- Past ocular history (trauma , surgery), medical history


Central scotoma


COLOR BLIND TEST


Normal Vision
What is Metamorphopsia?
It is a disorder of the eye which is characterized by the distortion in the vision of the eye.
It is commonly observed in individuals suffering from macular disorders.
For More Information:
Visit: www.epainassist.com
Metamorphopsia
(Distortion)

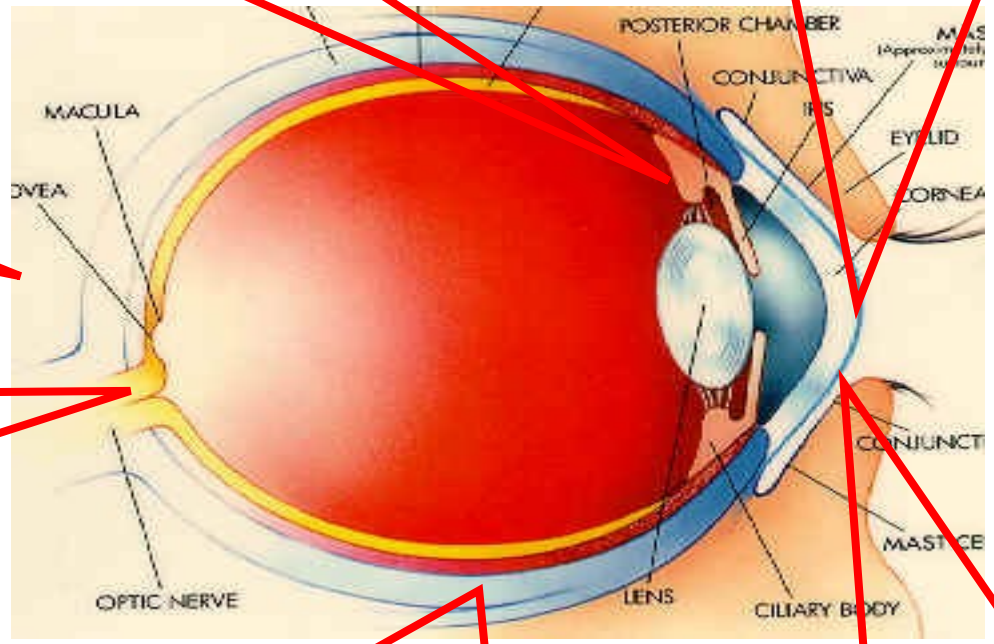

Diplopia
Diplopia

Symptomatology

Uveitis : Red eye, aching pain, photophobia , and blurring of vision.

Keratitis : pain, photophobia, tearing, red eye, decreased vision.

Exophthalmos: change of appearance, gritty eyes, diplopia, tearing tense orbits.



Optic neuritis:
acute loss of vision , pain
on eye movement, dychromatopsia.

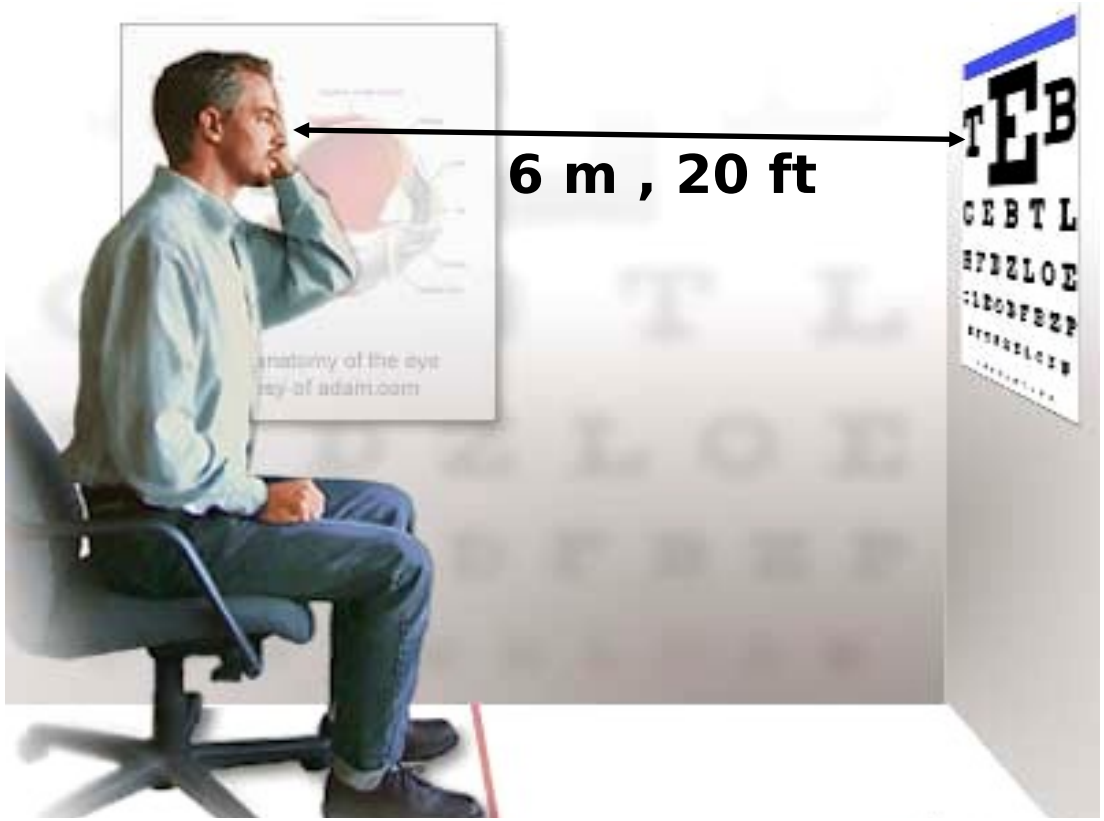
Scleritis : deep boring pain radiate to cheek , eye brow or temple, red eye, photophobia.

Dry Eye : burning ,itching, FB sensation , mucous threads crusting about the lashes.

Vision

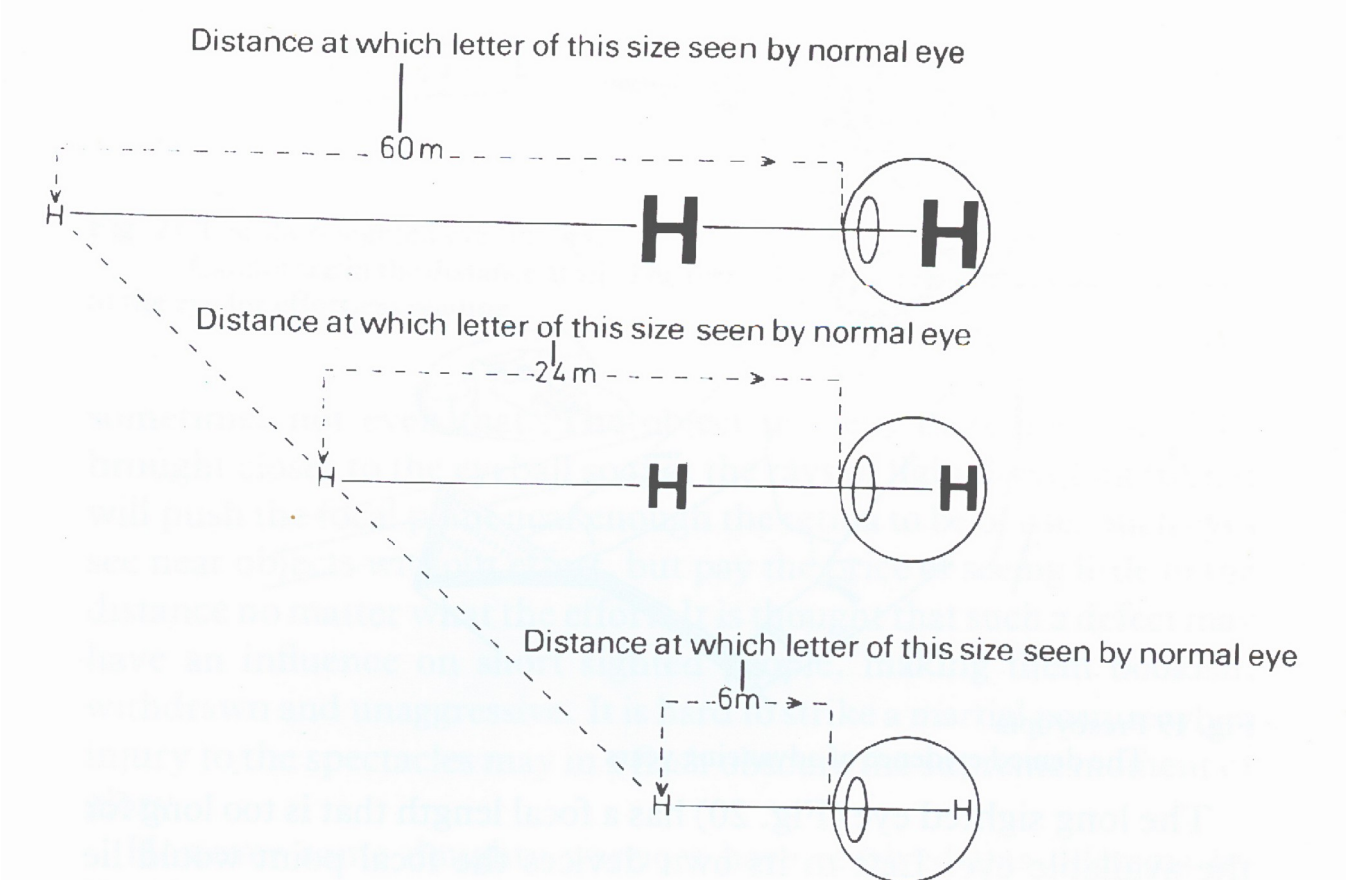
- Vision has several specific aspects:
  - Form vision [**visual acuity**]: the ability to discriminate details tested by Visual Acuity charts
  - Color vision: the ability to discriminate colors tested by **Color vision tests**
  - Contrast: the ability to discriminate details in low contrast tested by **contrast Sensitivity Charts**
  - Field of vision: the area of space recognized by the eye(s), tested by **Perimetry**
  - Night vision: the ability to discriminate in low illumination (scotopic) conditions, tested by Dark Adaptation
  - Glare: the ability to discriminate against dazzling background illumination, tested by Glare meters

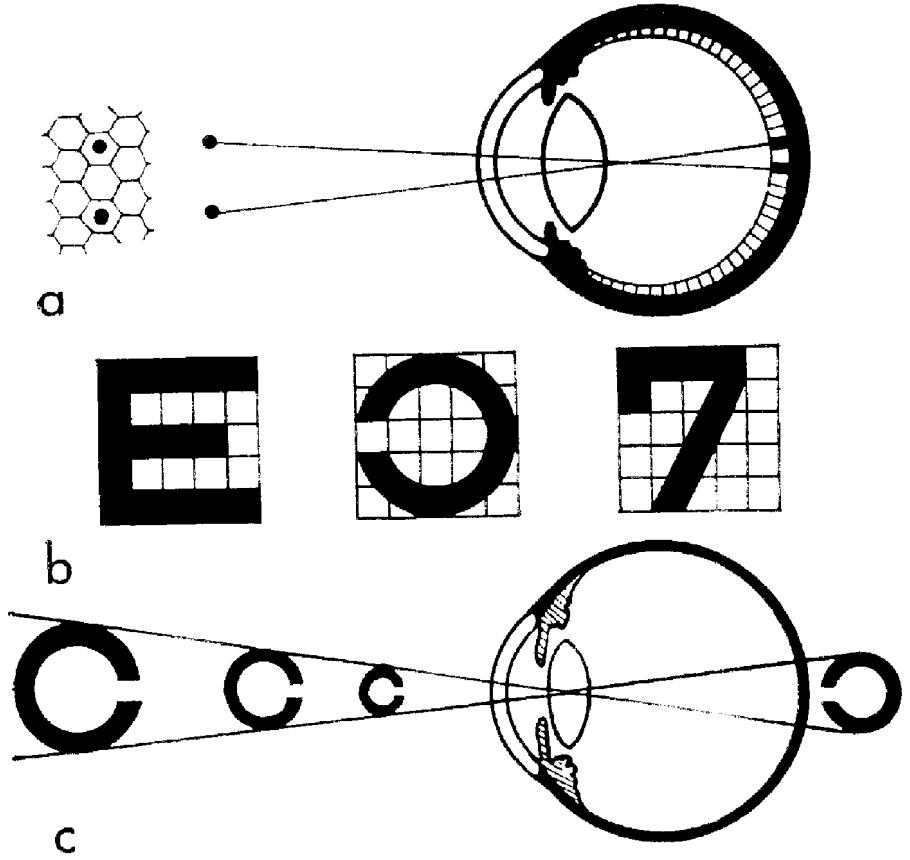
Snellen Visual Acuity



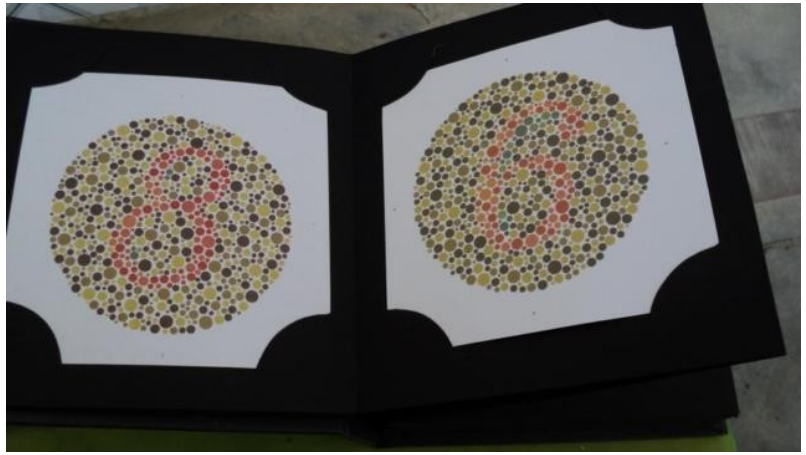
Optotypes

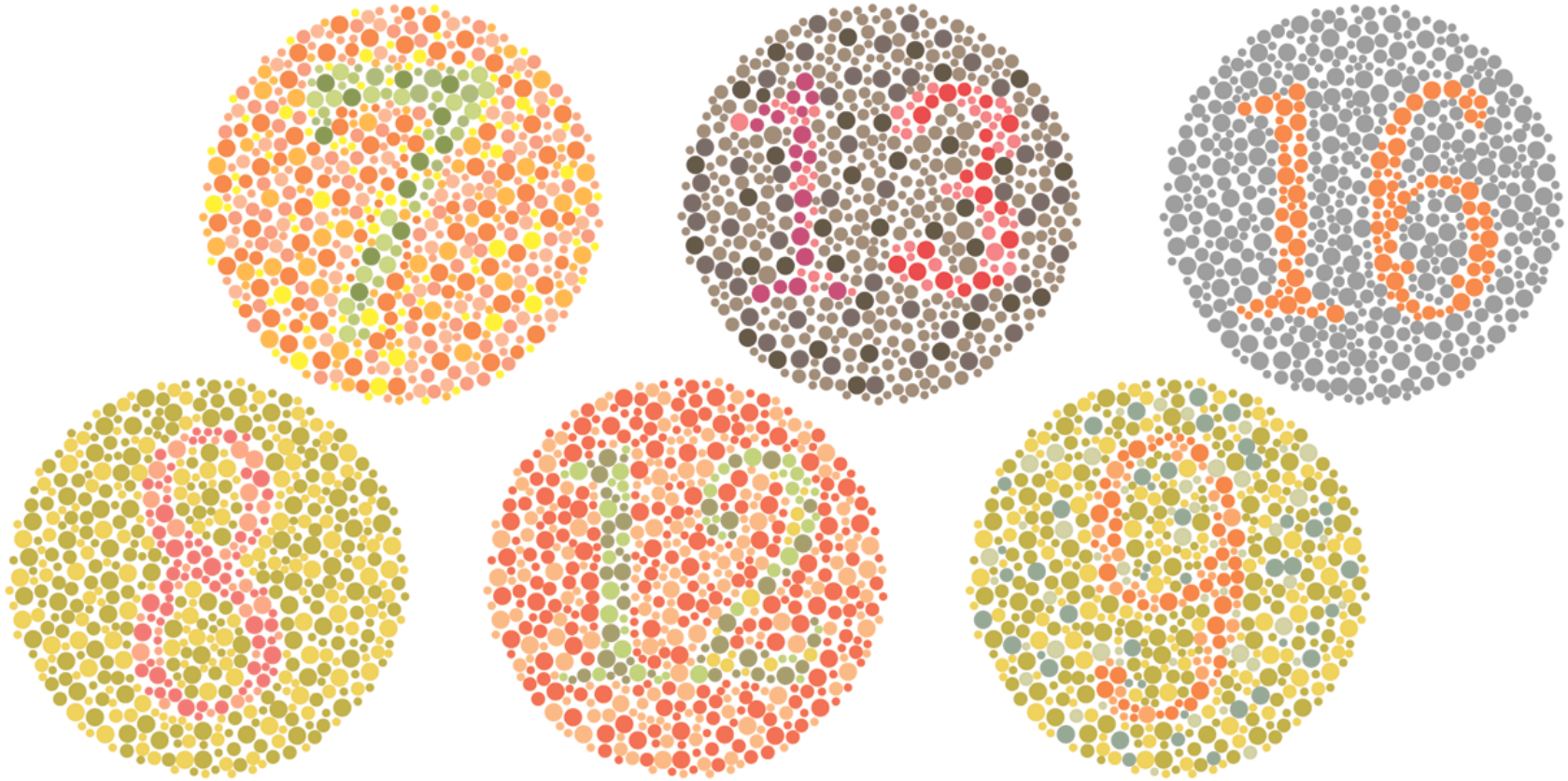
Visual Acuity





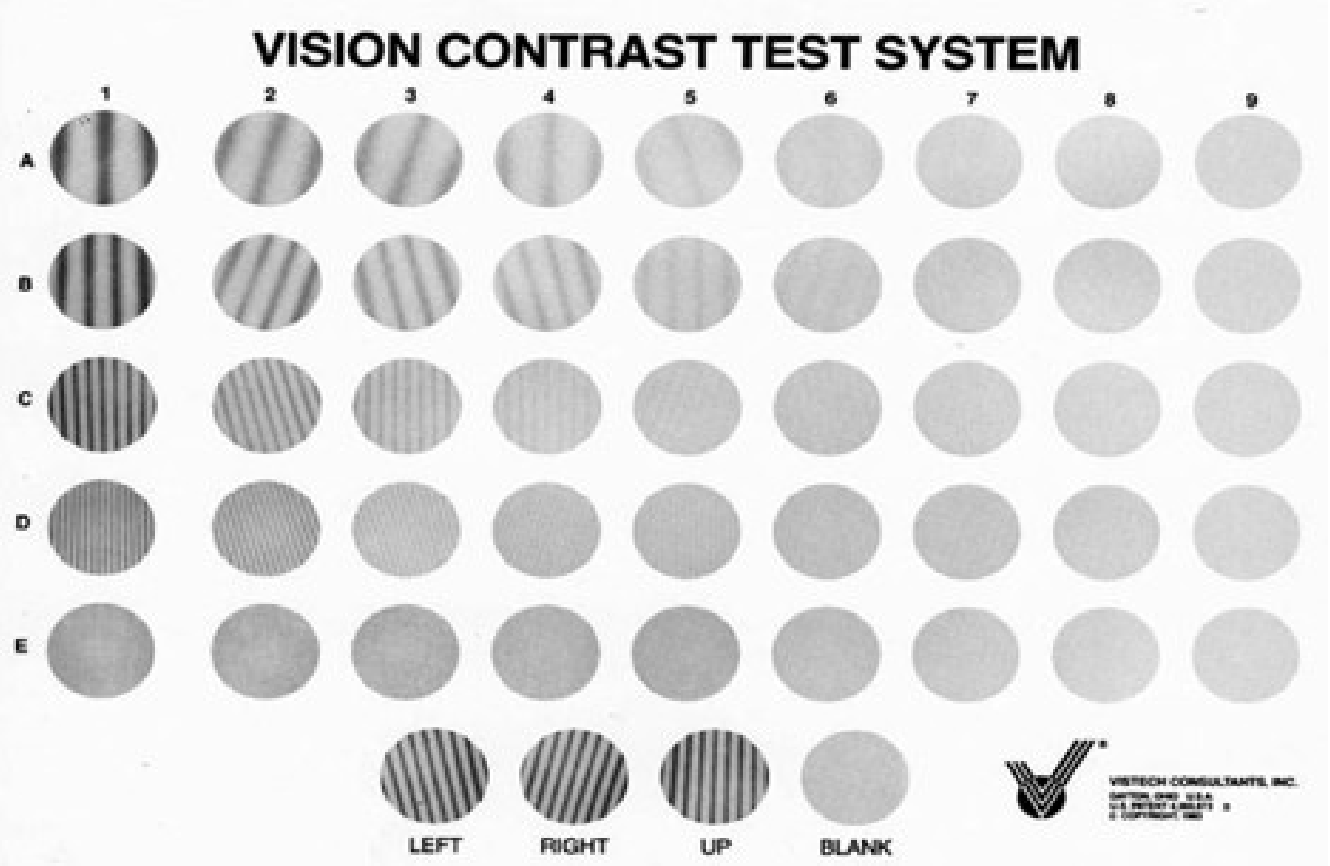
Color vision testing





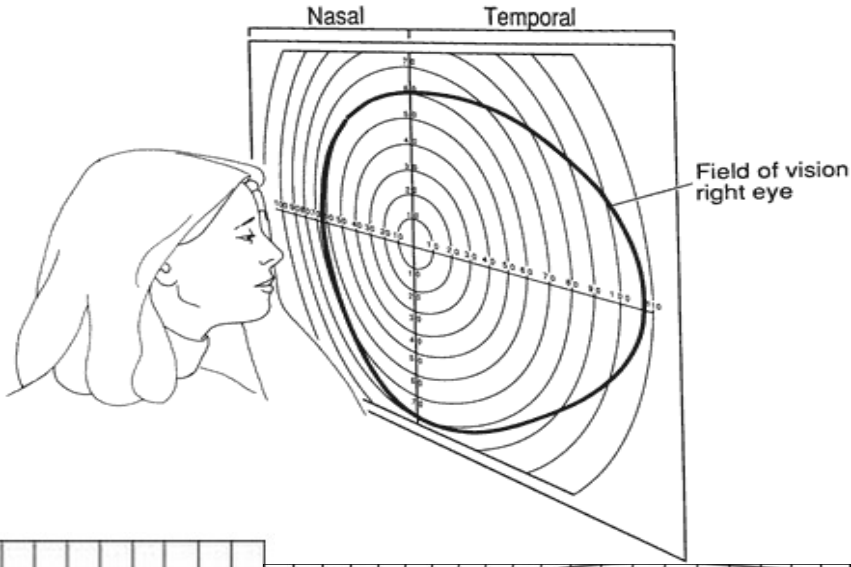
Ishihara Test

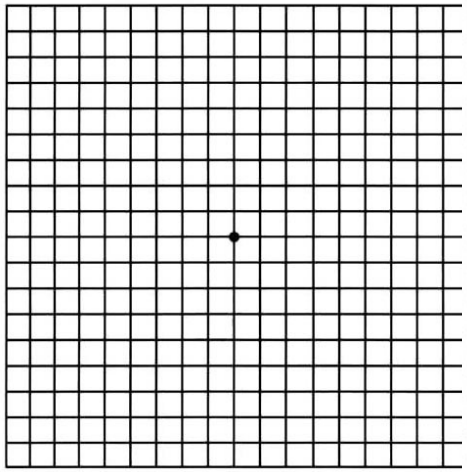
Contrast Sensitivity Testing

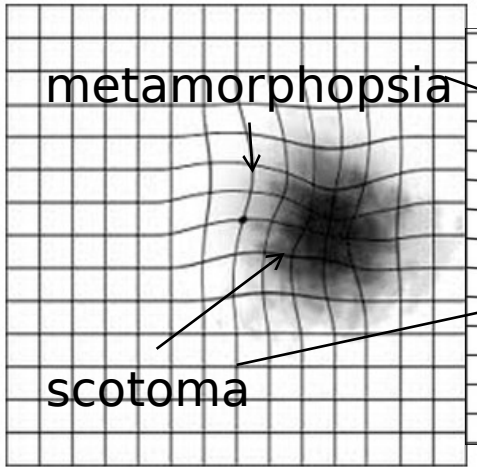


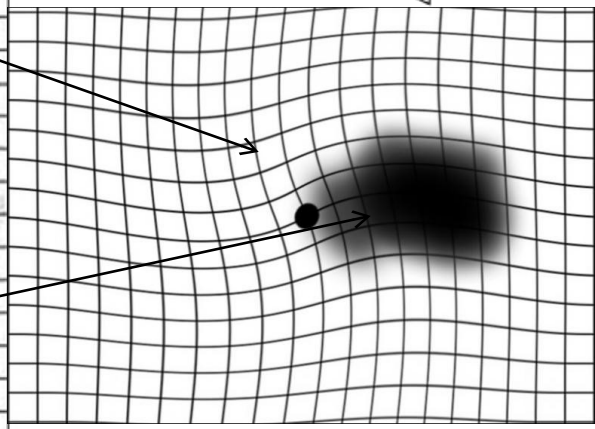
Field of Vision Testing

- Confrontation testing
- Amsler's grid
  macula
- Kinetic perimeter
- erimeter

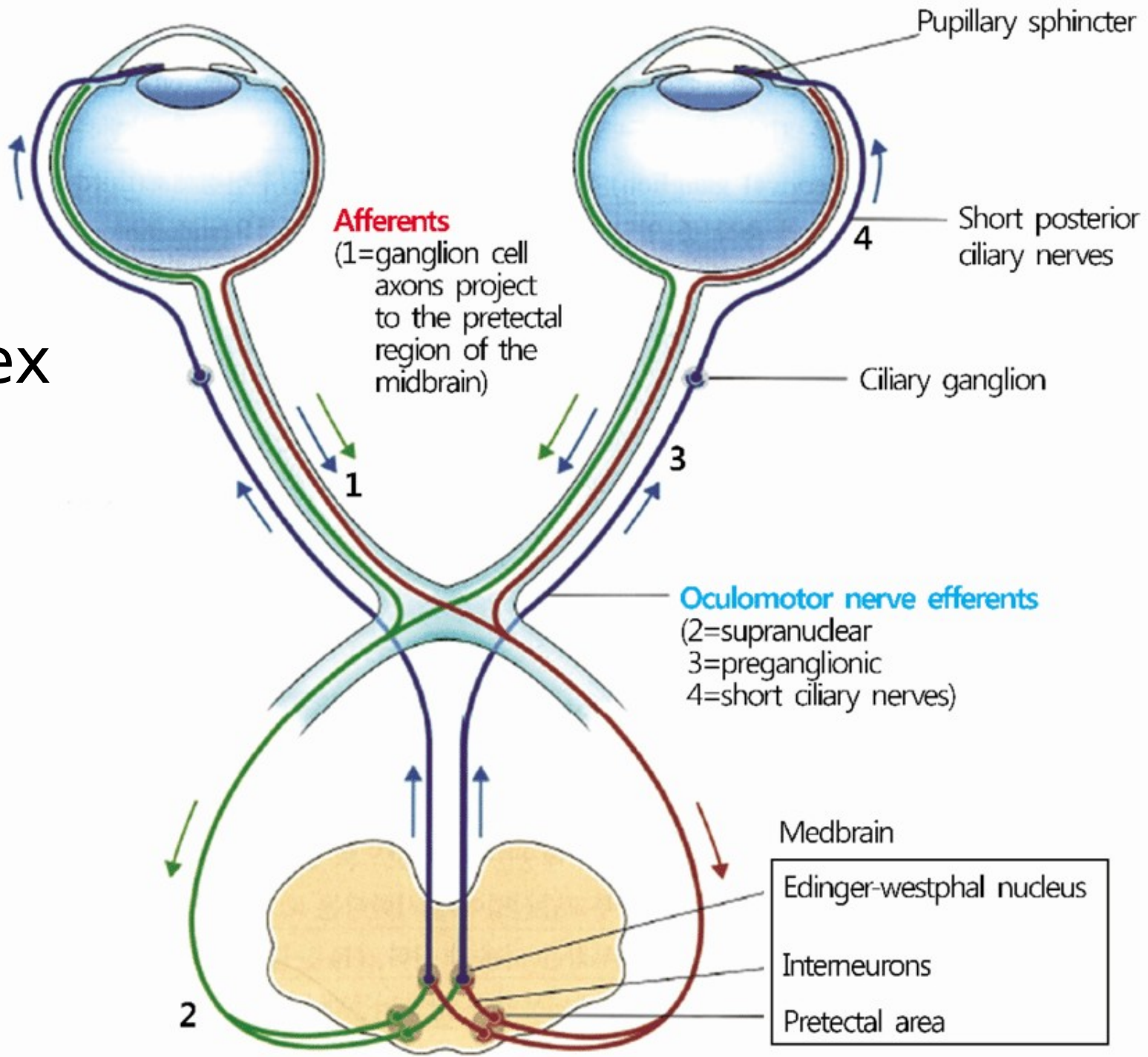






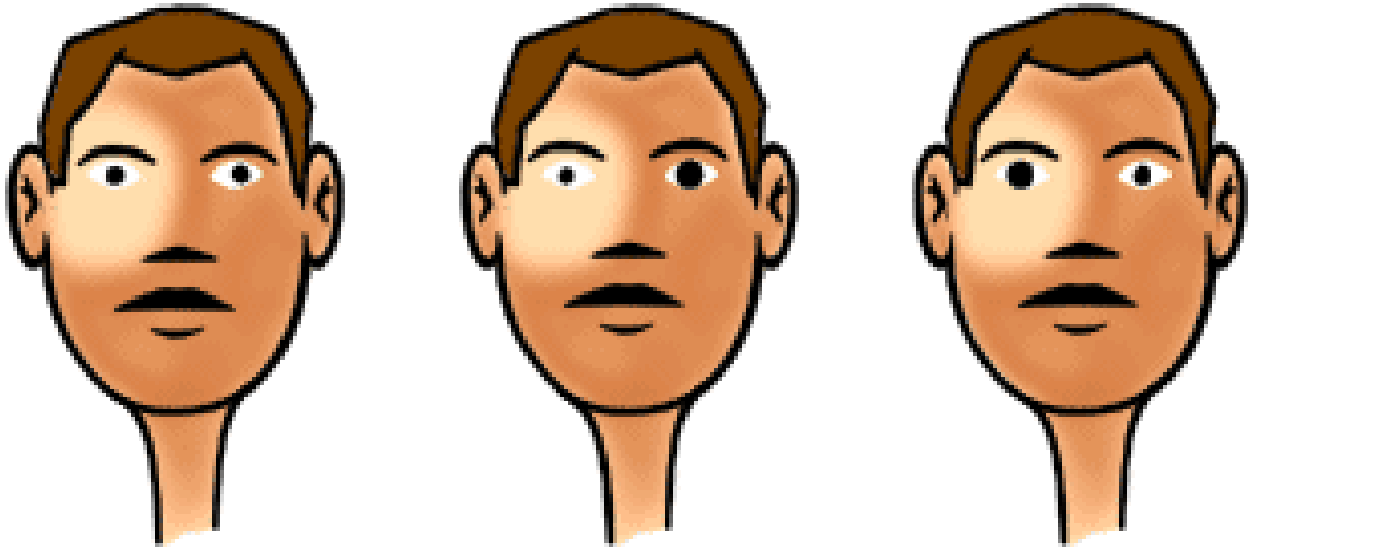


Pupillary Light Reflex

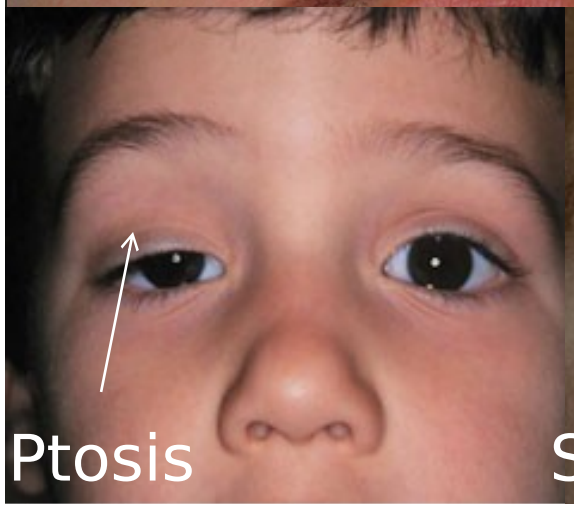


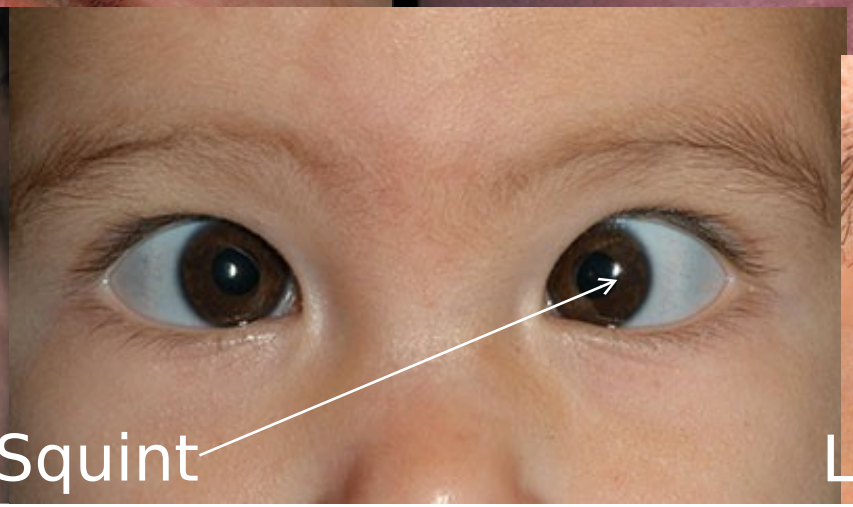
Pupil Examination

Direct reaction
Consensual reaction
Near reaction



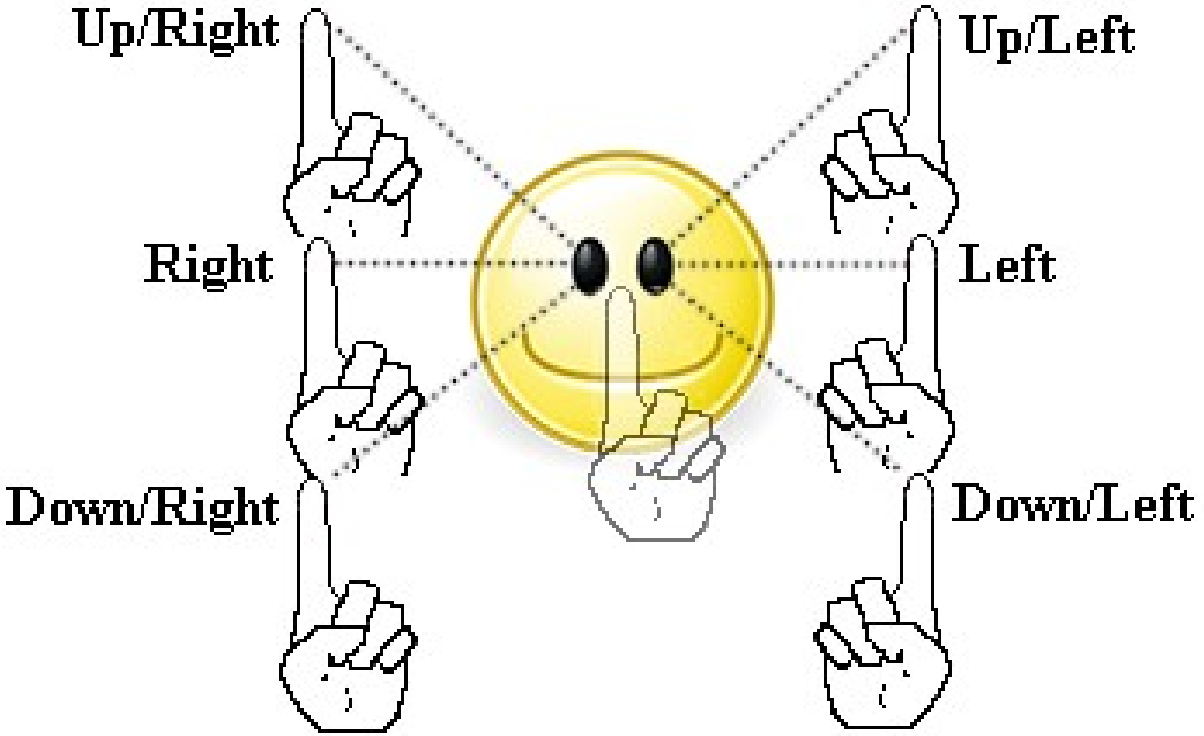
Basic Ocular Examination
External Appearance





Basic Ocular Examination
Motility

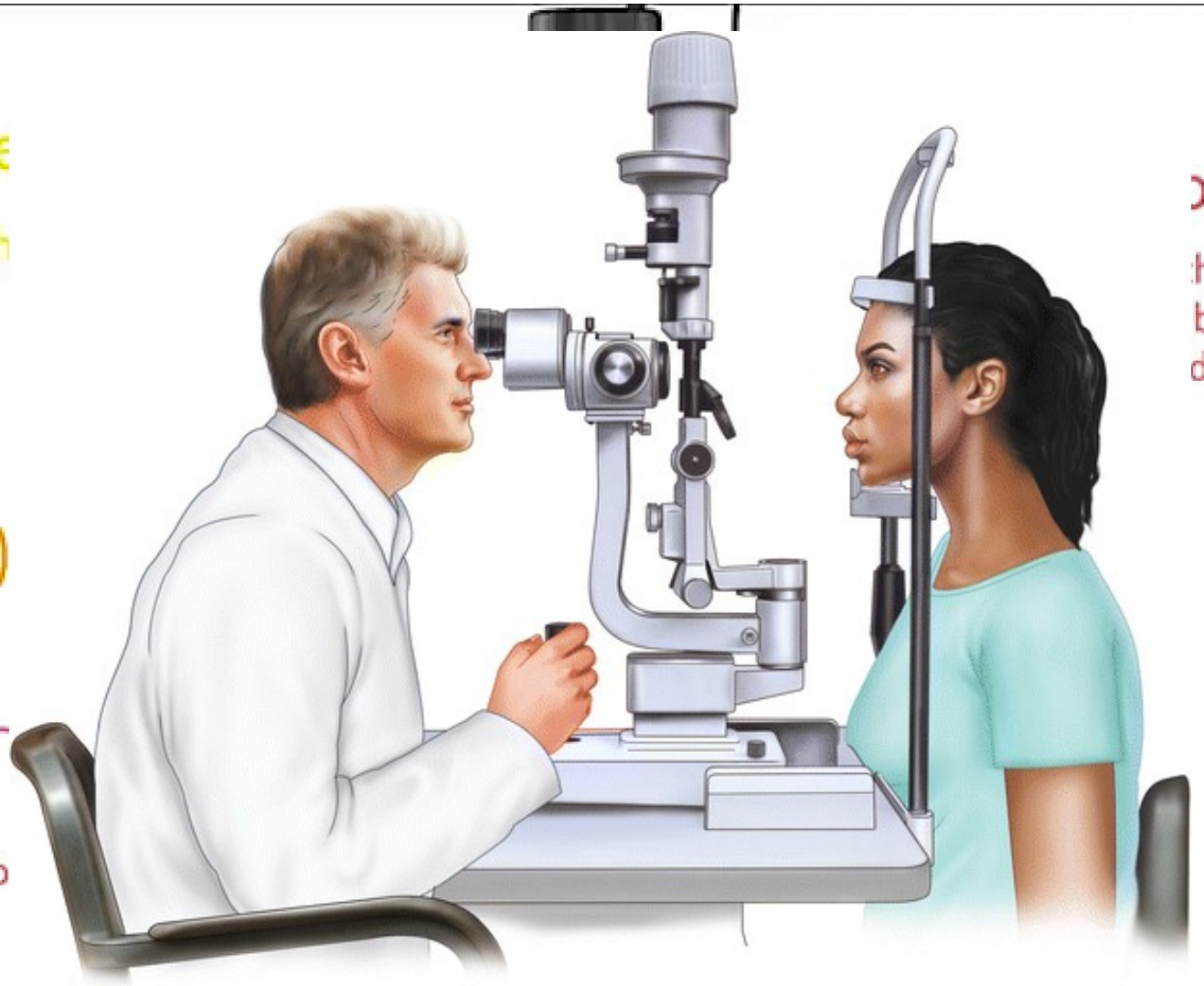
- Cardinal directions
- Gaze
- Ductions



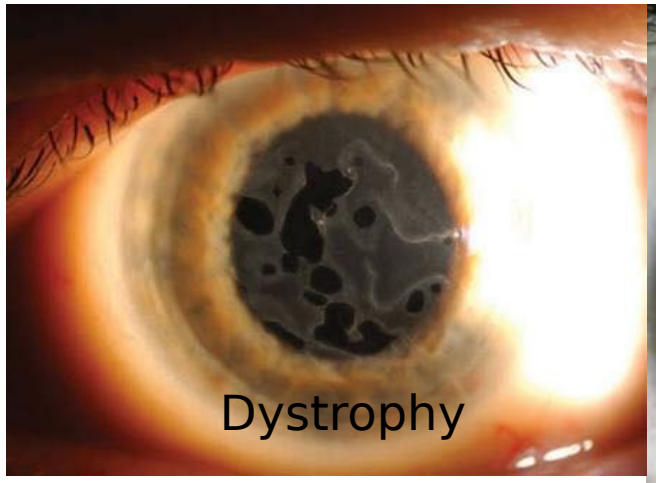
Basic Ocular Examination
Red Eye

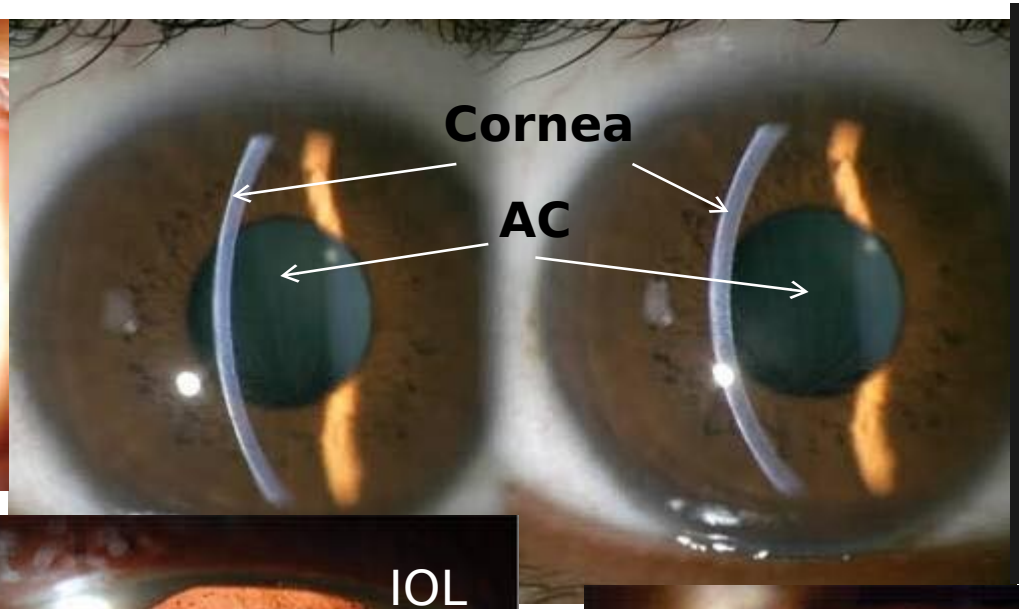
- Conjunctival injection
- Ciliary injection: circumcorneal
- Discharge: watery, mucoid, mucopurulent, purulent
- Lid eversion: follicles, papillae, fibrosis
- Acute red eye
- Chronic red eye

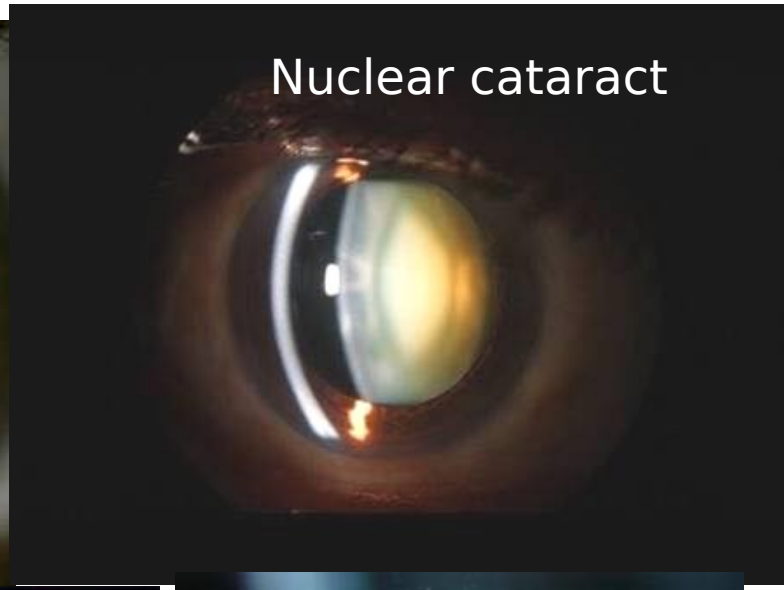
Slit Lamp

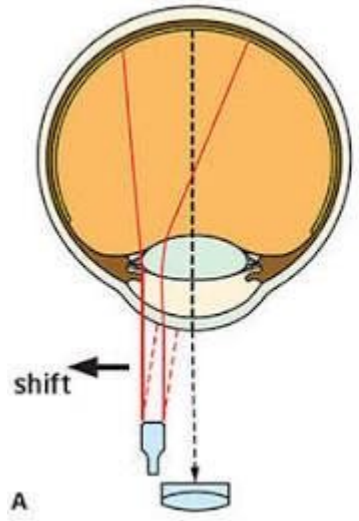


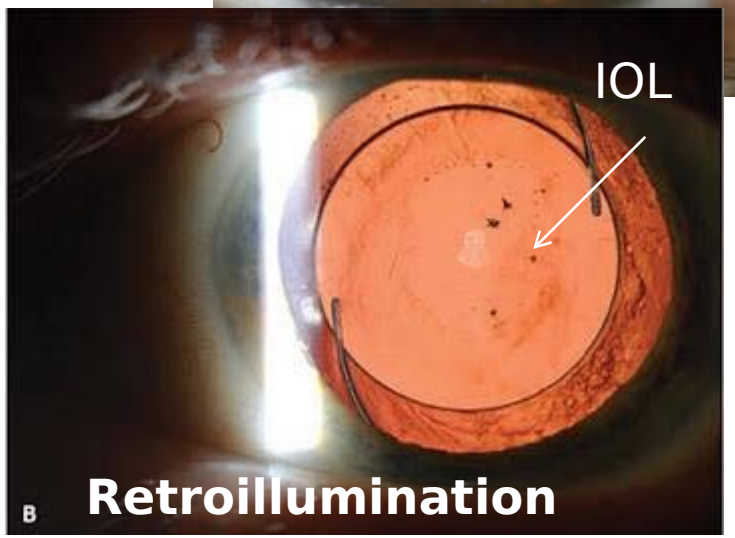
Slit Lamp

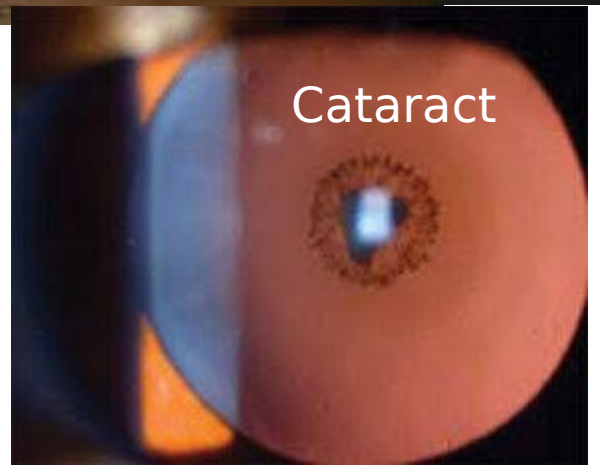

Dystrophy

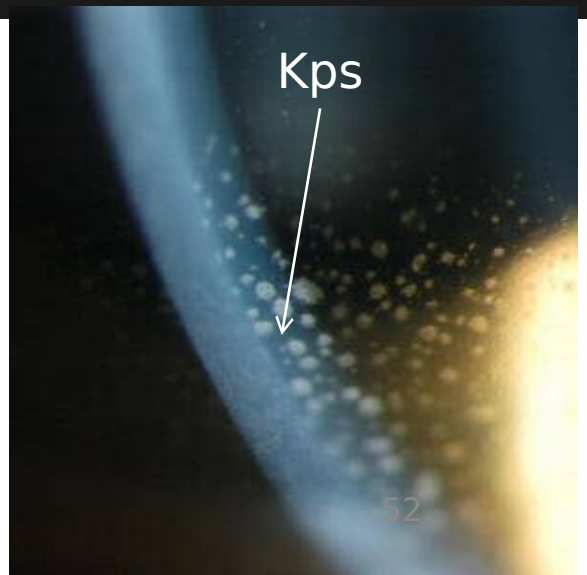

Cornea
AC


Nuclear cataract


shift
A

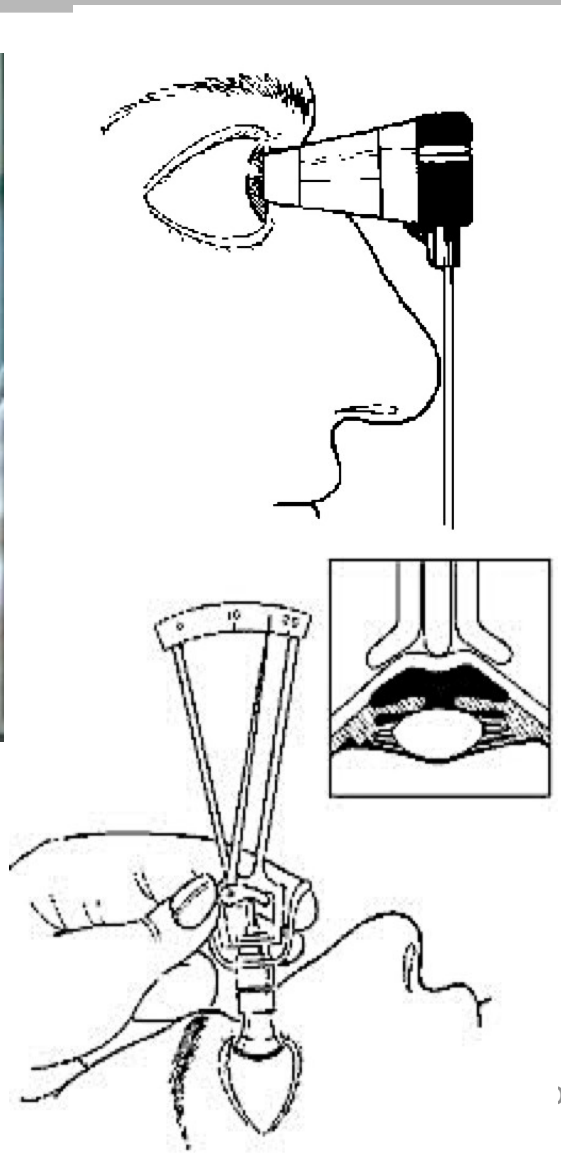

IOL
B
Retroillumination

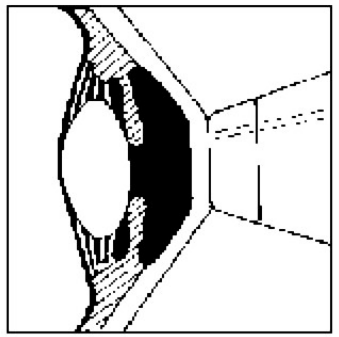

Cataract

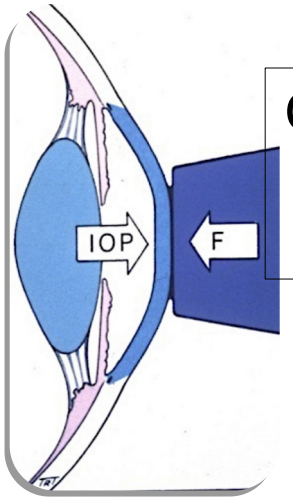

Kps

IOP Measurement

Digital Method







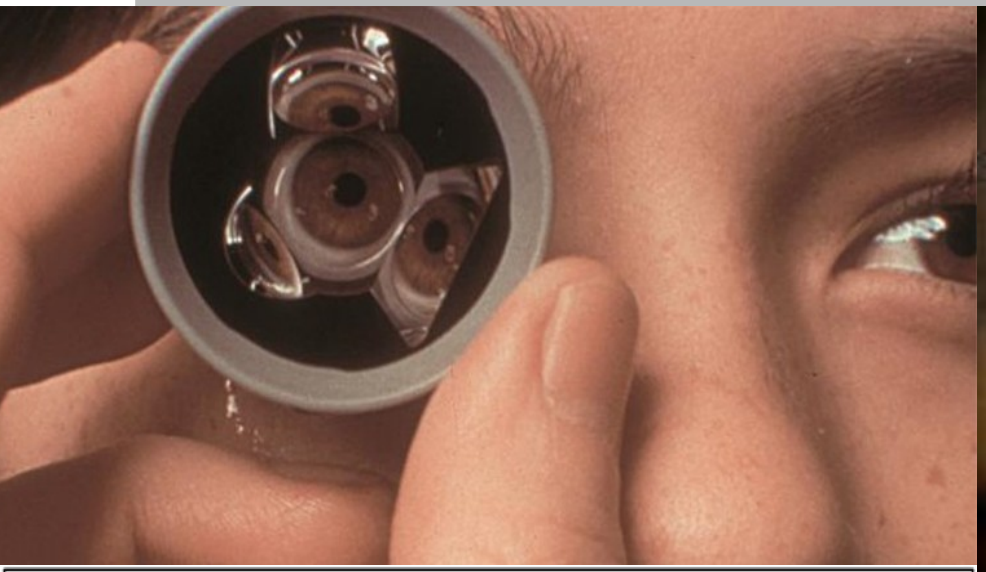
Goldman, Applanation Tonometer (On slit lamp)

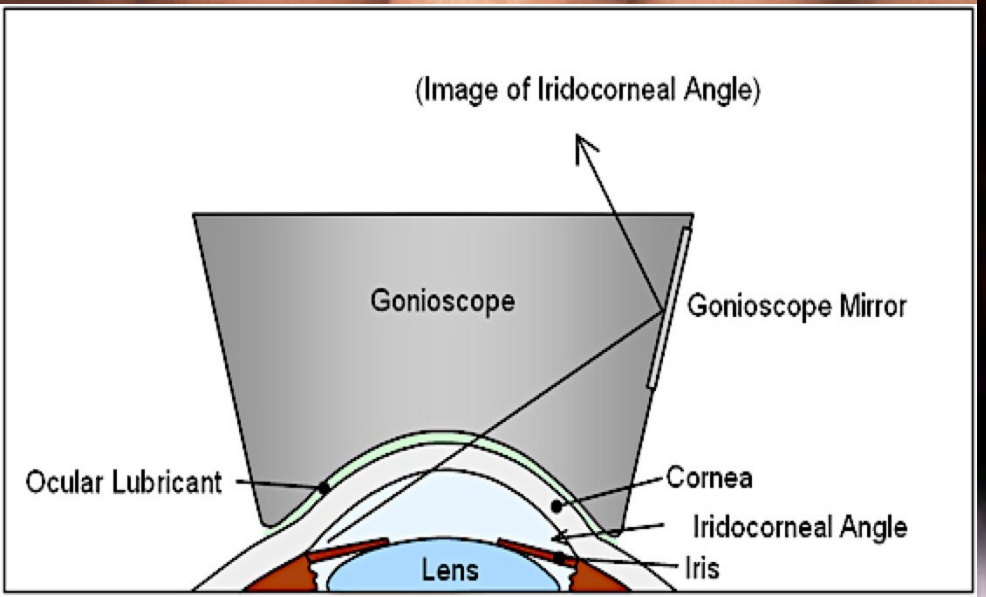
Schiotz, Indentation Tonometer (On bed)

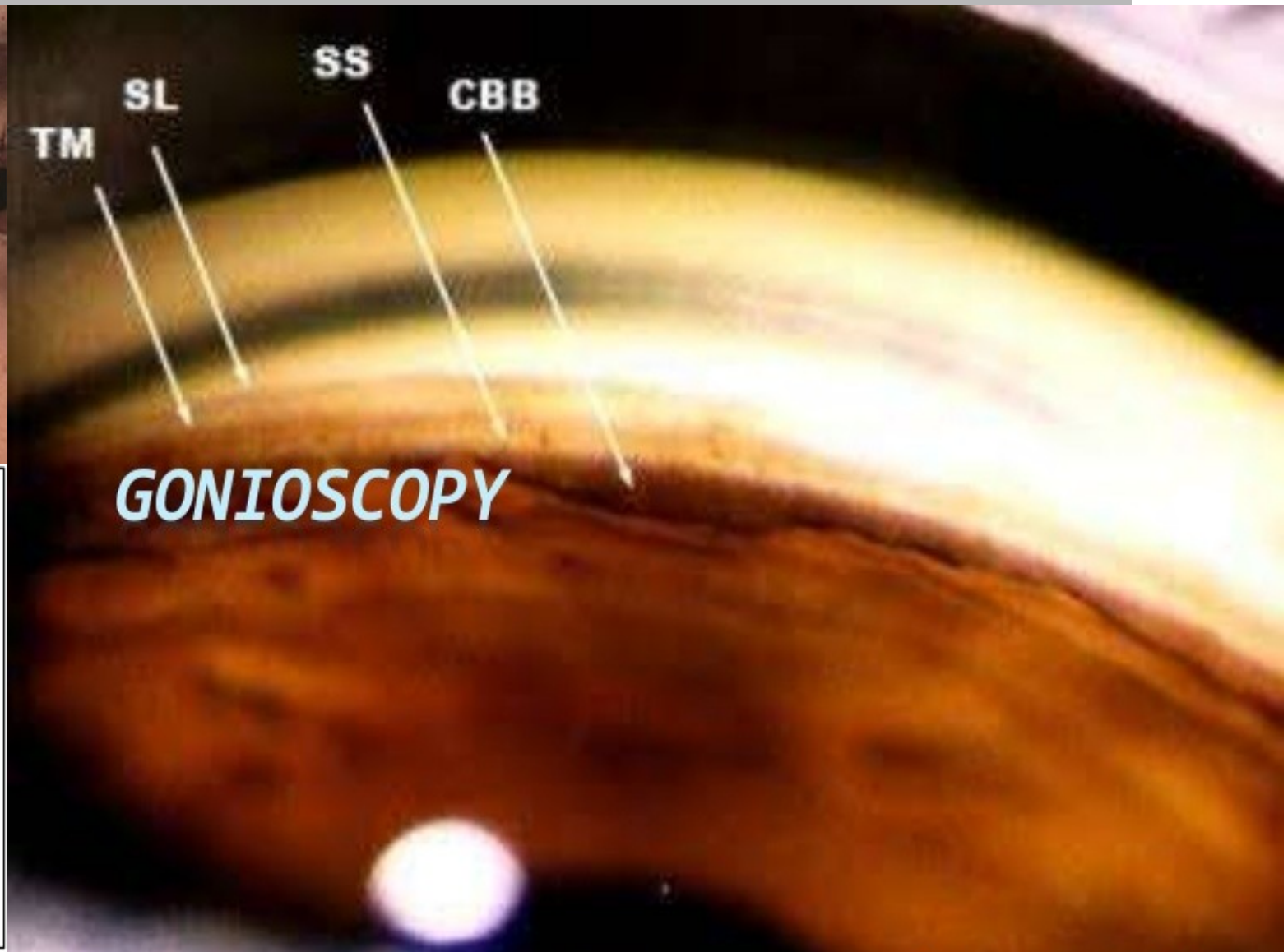
IOP measurement (Tonometry)

- Digital estimation
- Schiotz (indentation) tonomter
- Goldman (Applanation) tonomete
- Air-Puff tonometer
- Tonopen

Gonioscopy angle of chamber







Posterior Segment Examination

Indirect Ophthalmoscope

Direct Ophthalmoscope

Fundus Examination

Direct Ophthalmoscope

Indirect Ophthalmoscope

Slit lamp biomicroscopy

Fundus can

Hertel's Exophthalmometer

The normal range is **12–21 mm.**
A difference greater than **2 mm between the eyes** is significant.
Axial Length of the eye affects exophthalmometer reading. **Pseudoproptosis** may be seen in severe myopia.

Ocular Investigations

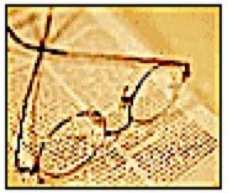
AS INVESTIGATIONS

- Pachymetry
- Keratometry
- Biometry
- Corneal topography
- AS-OCT
- Specular microscopy
- Ultrasound biomicroscopy

PS INVESTIGATIONS

- Ultrasonography [US]
- Perimetry
- Fundus fluorescein angiography [FFA]
- Indocyanine green angiography [ICG]
- Optical coherence tomography [OCT]
- Fundus Autofluorescnce [FAF]
- Electroretinography [ERG]
- Electro-oculography [EOG]
- Visual-evoked potential [VEP]

Keratometry



Spectacle Rx:

-2.00 -1.75 x 180

Keratometry:

44.00 / 46.00 @ 090

Spherical RGP | Calculate | Reset Form

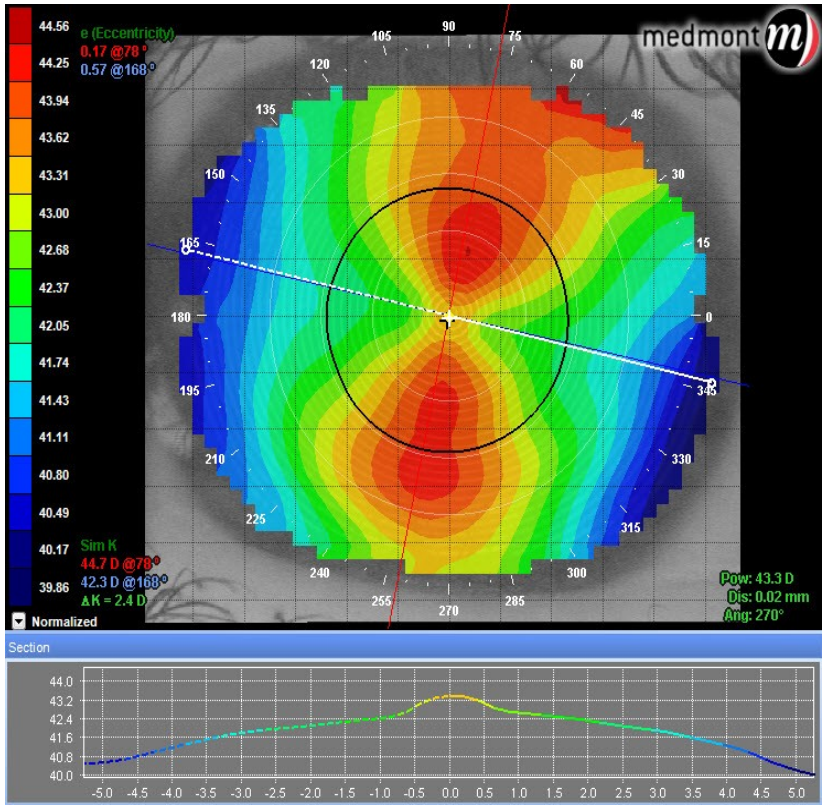
Suggested Lens:

Power: -2.50
Base curve: 7.58 (44.50)
Diameter: 9.0
Optic Zone: 7.8
Peripheral curves:
8.58/.2mm, 11.25/.4mm

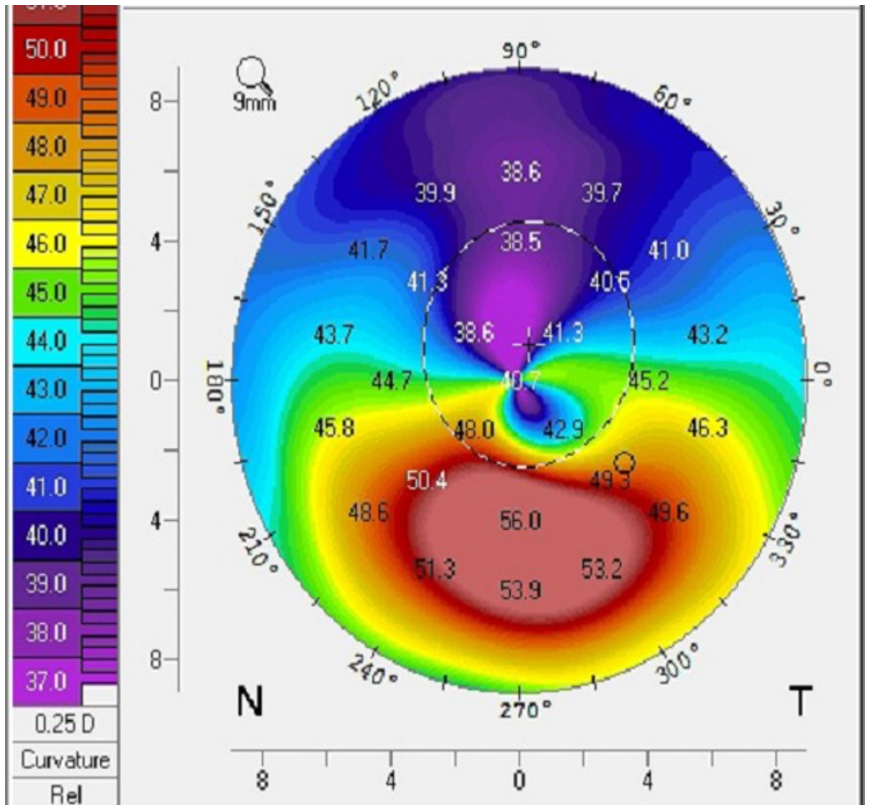
Some thoughts...

A spherical RGP would leave about 0.25 D of residual astigmatism. Being a fairly low magnitude and because it's WTR astigmatism, the patient will likely tolerate it well.

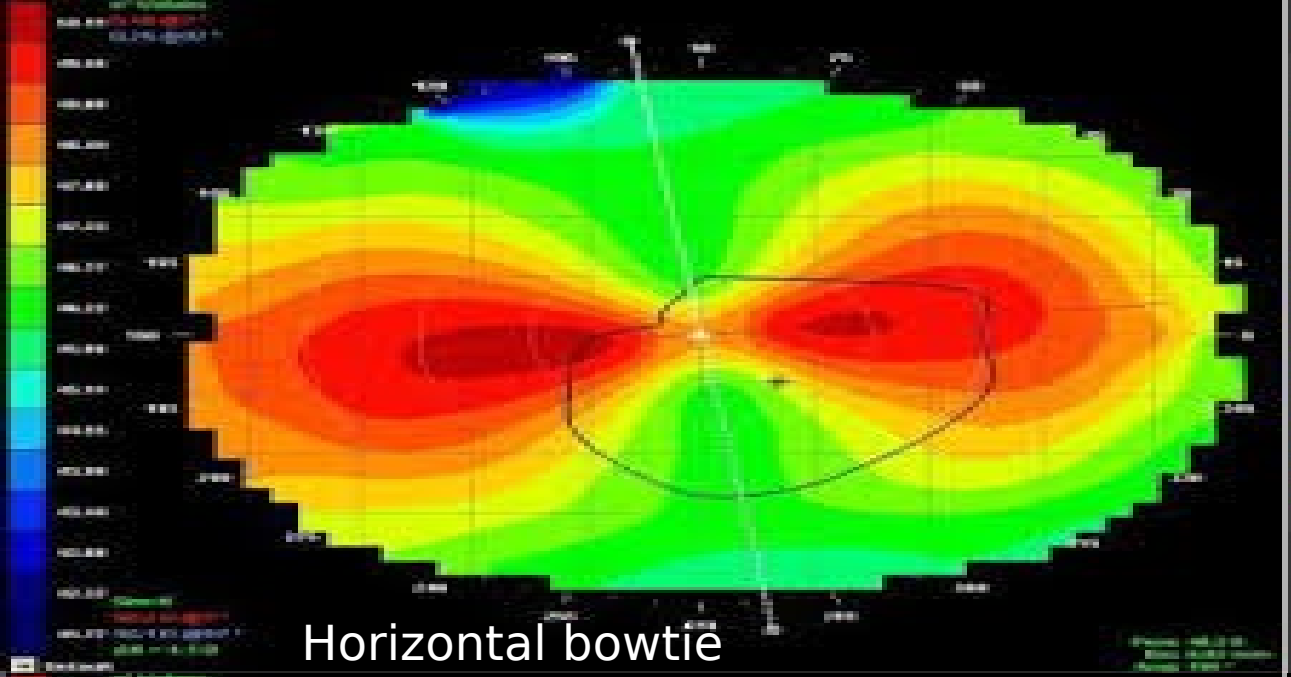
Corneal Topography & Pachmetry



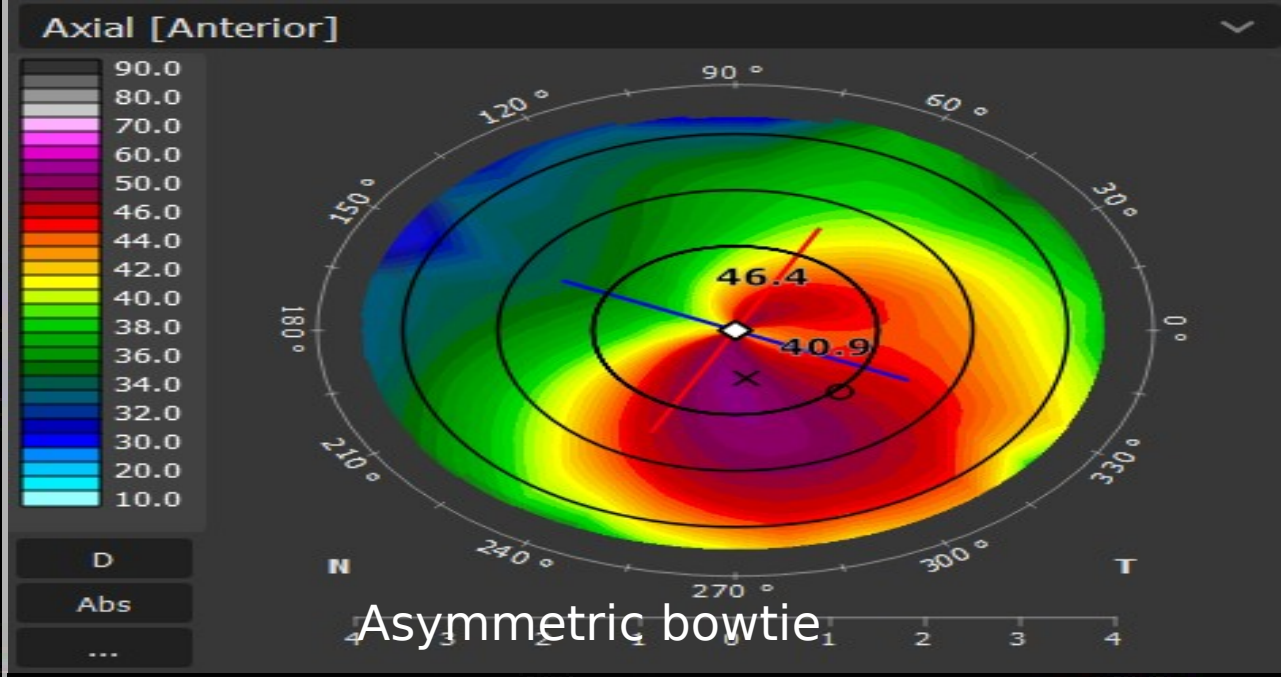
Vertical bow-tie



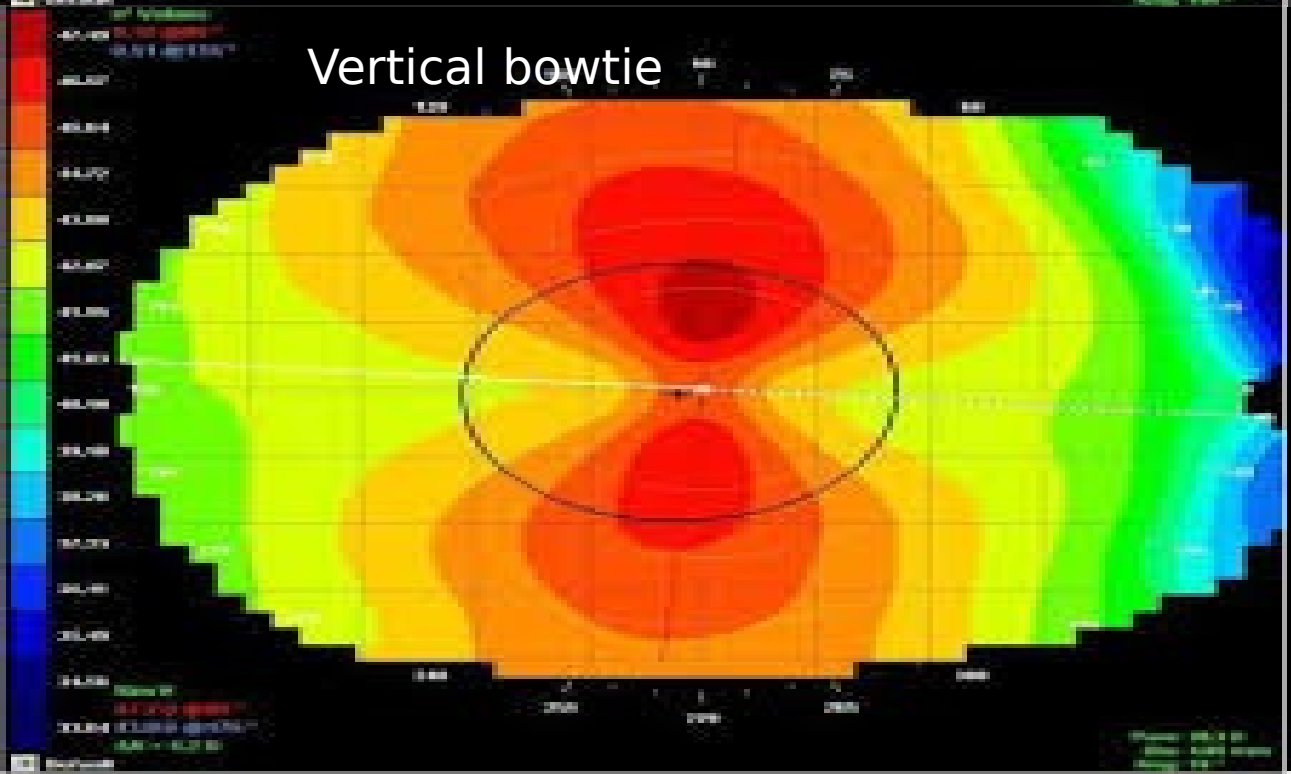
Keratoconus



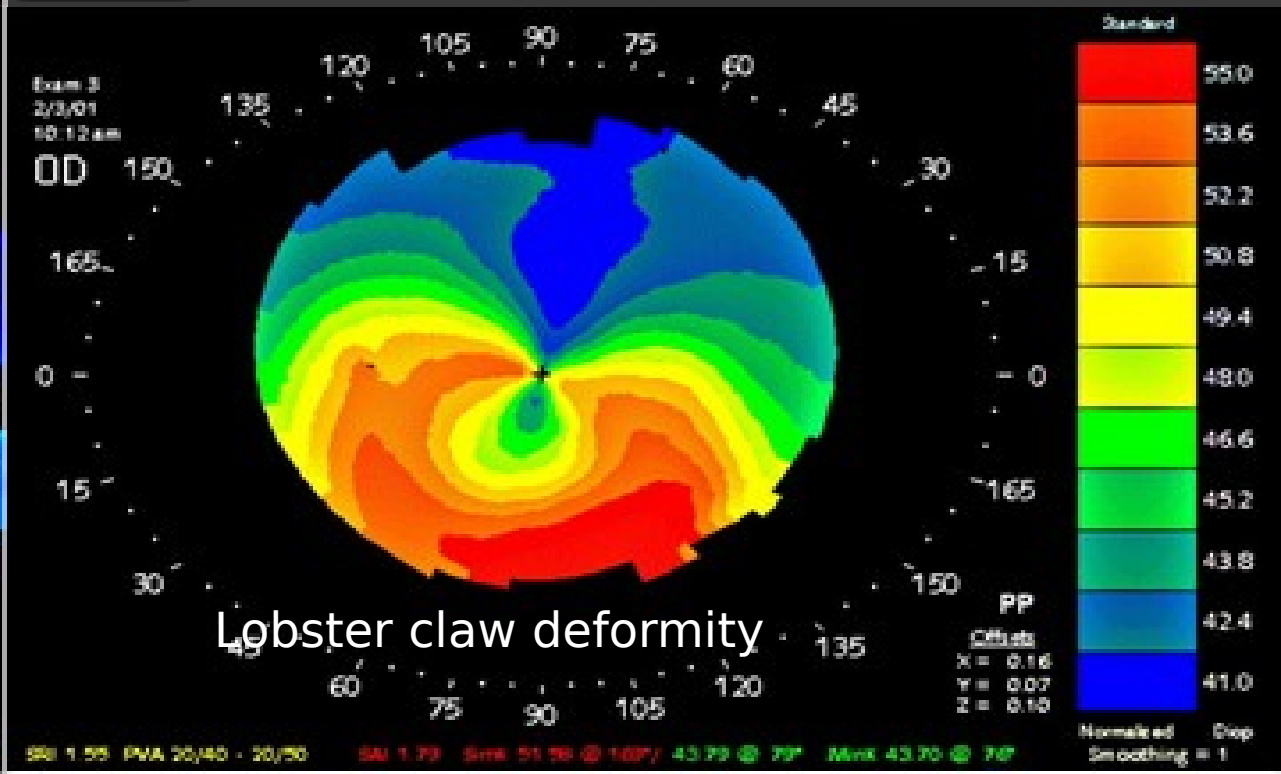
Horizontal bowtie



Asymmetric bowtie

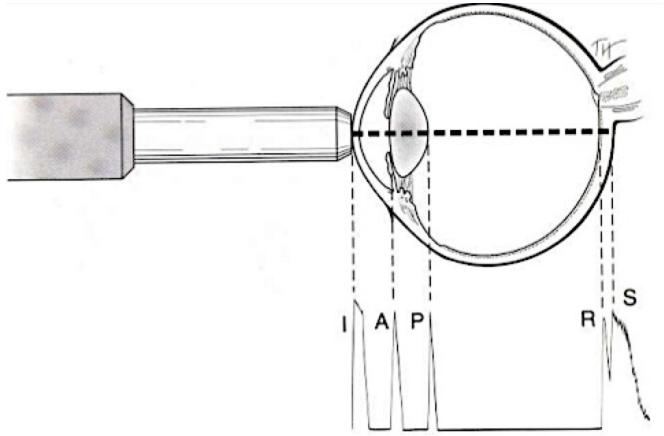


Vertical bowtie



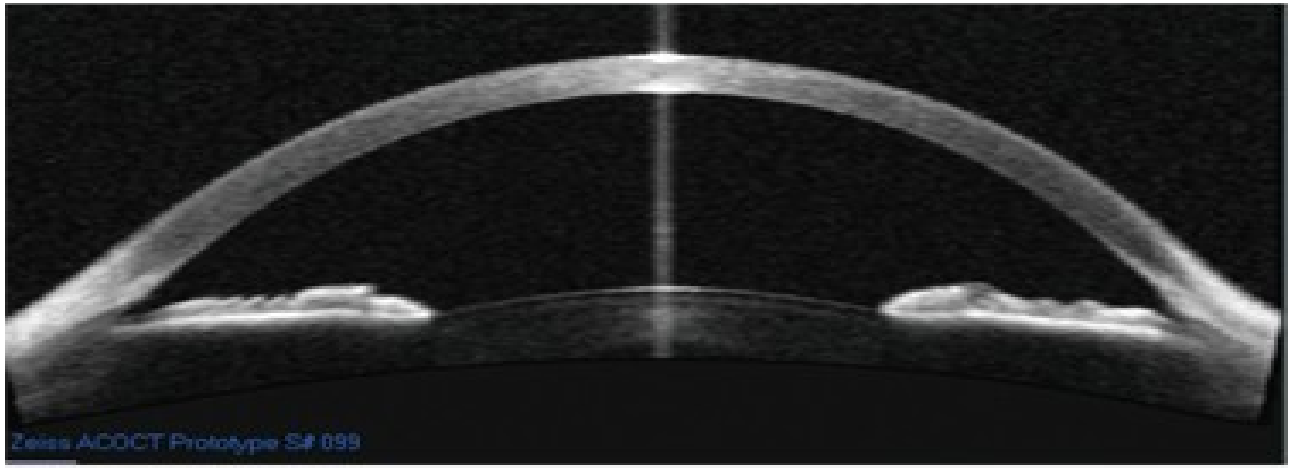
Lobster claw deformity

Biometry [IOL power]

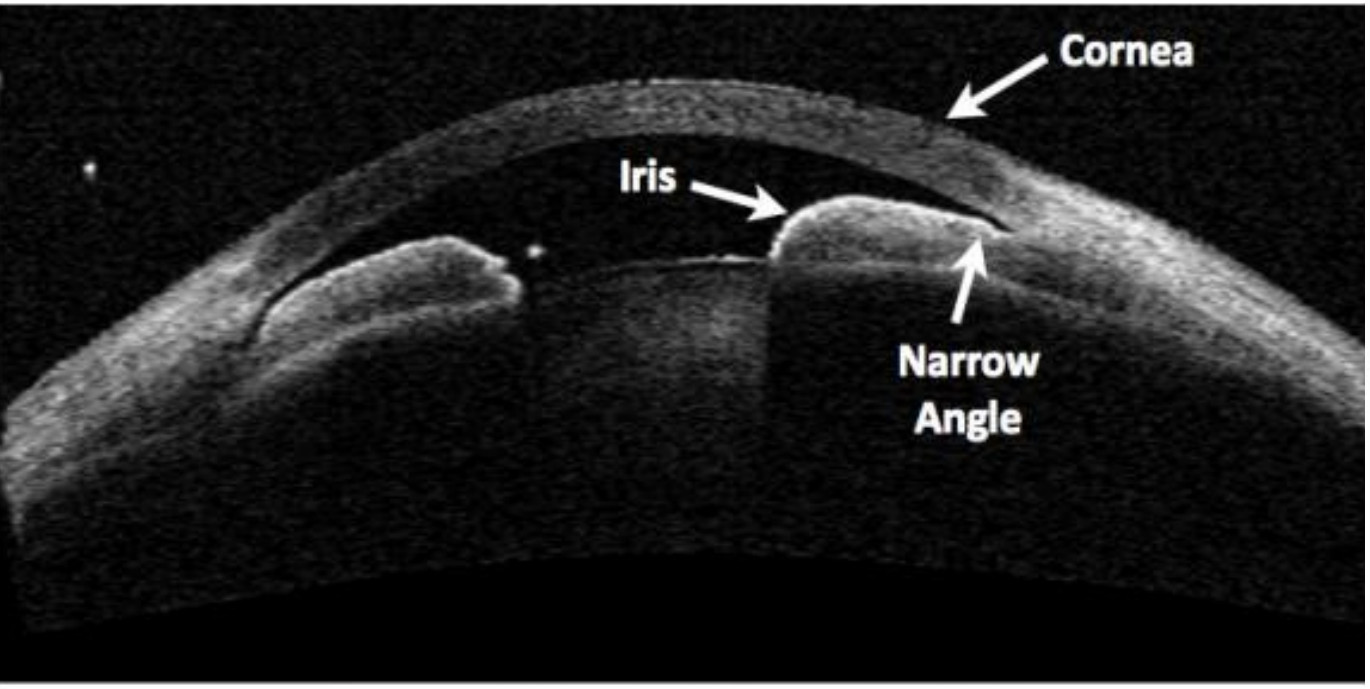


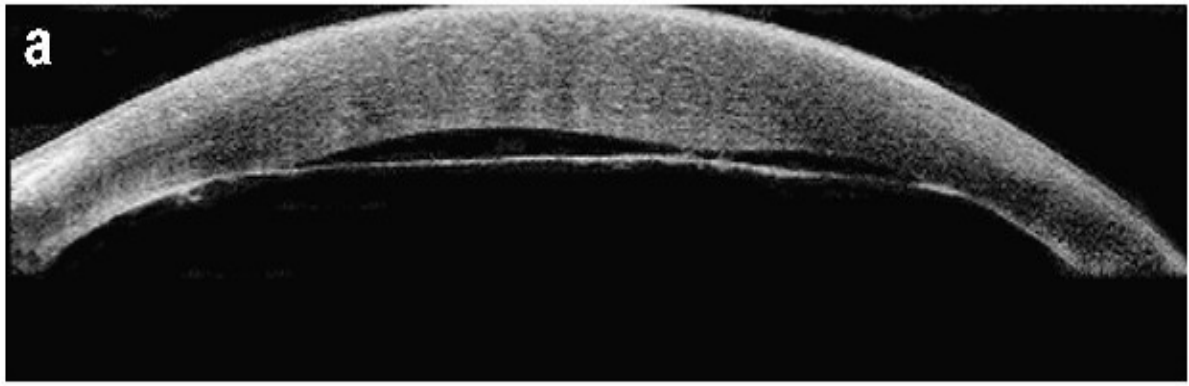
Ultrasound

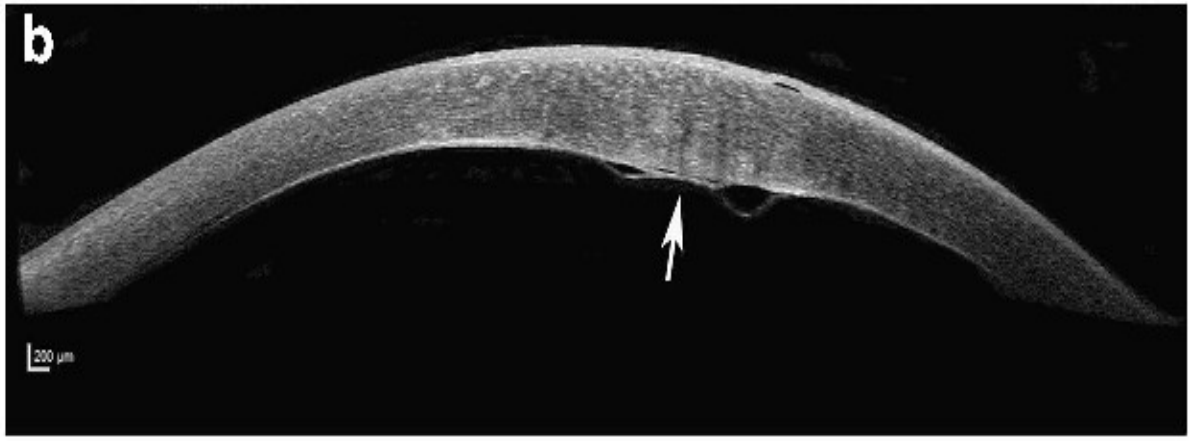
Optical

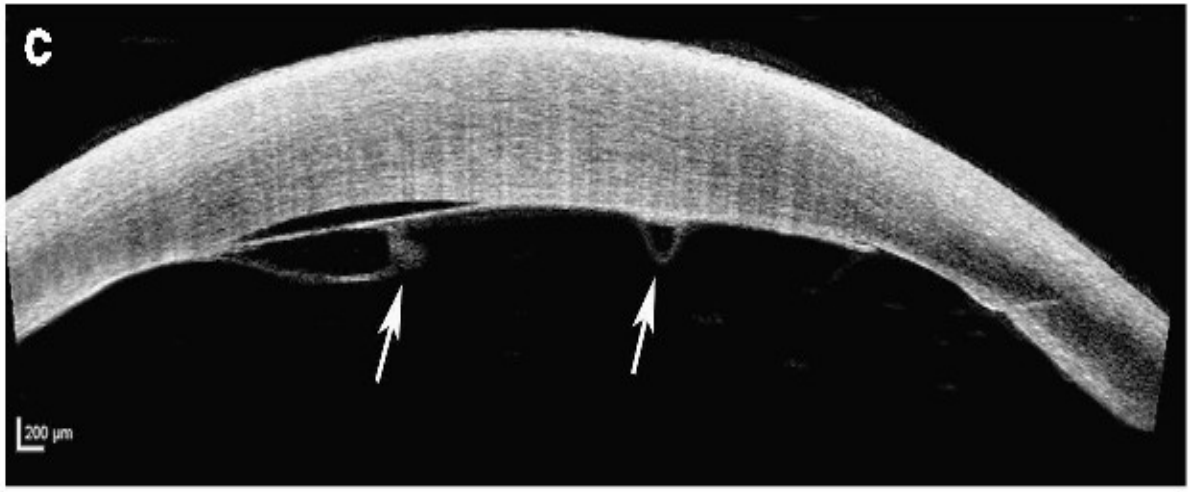


Cross-sectional image of the anterior segment made by AS-OCT prototype (Carl Zeiss Meditec Inc.)

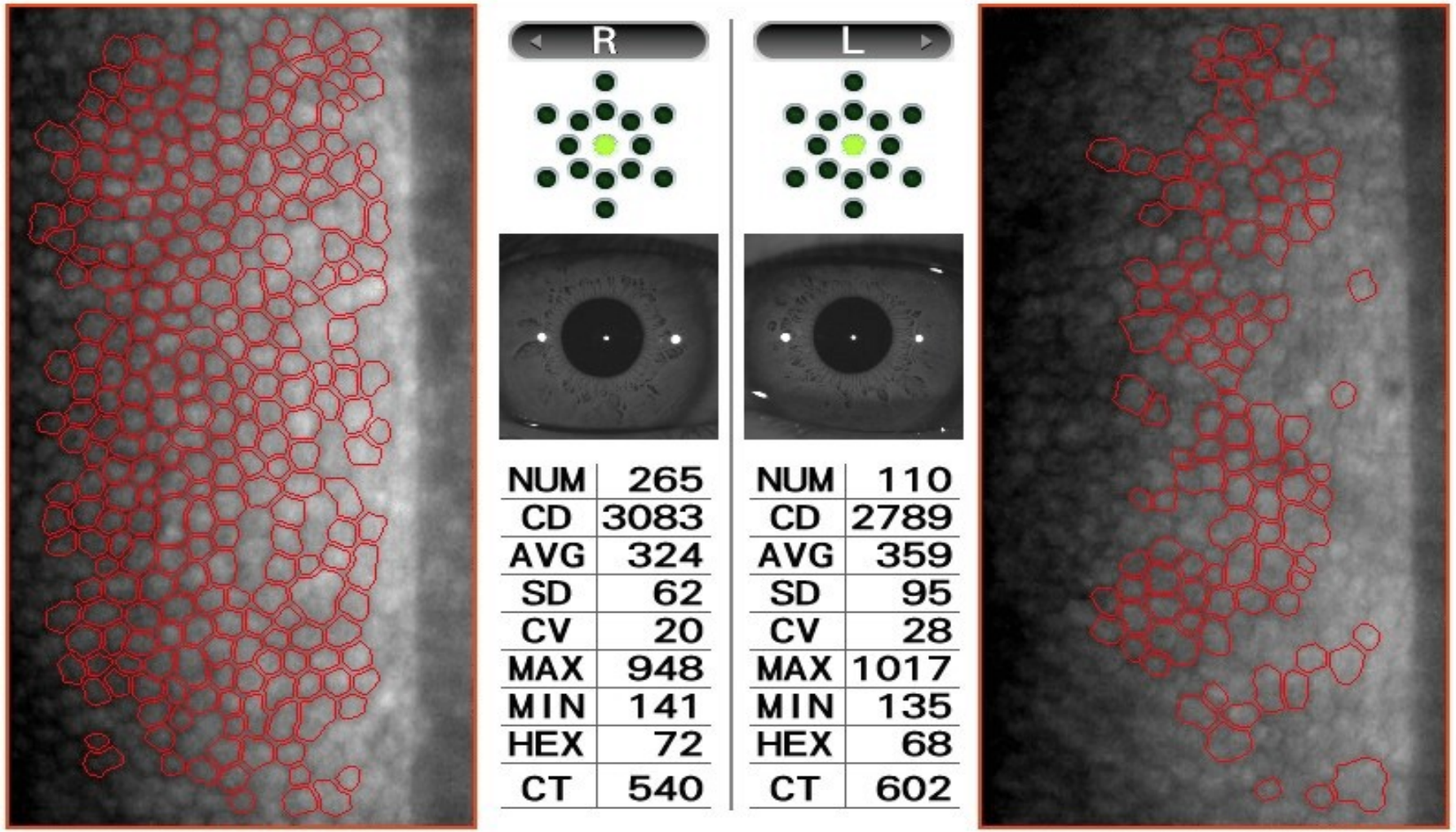




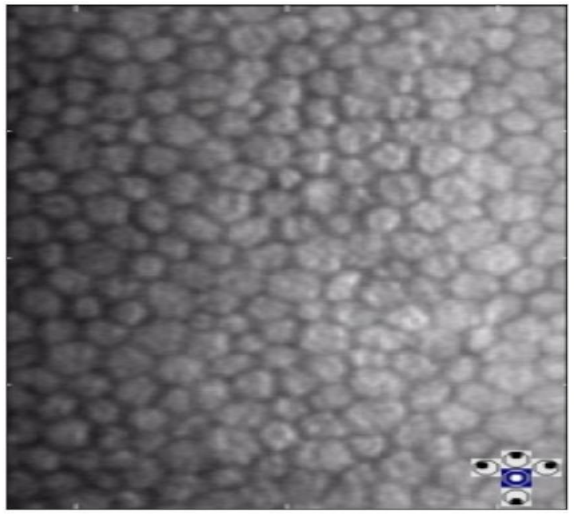




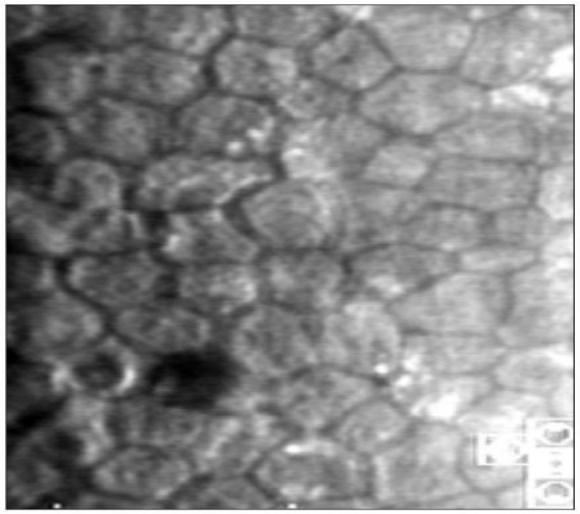
Specular Microscopy



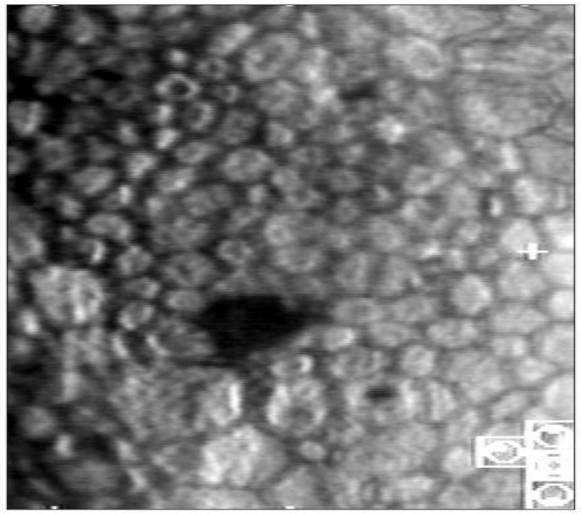
Cornea Endothelium



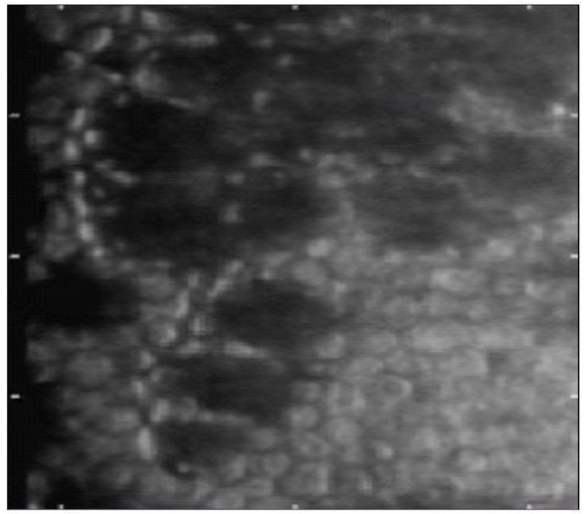
Normal Endothelium
High Cell Density



Very Low Density
High Surgical Risk

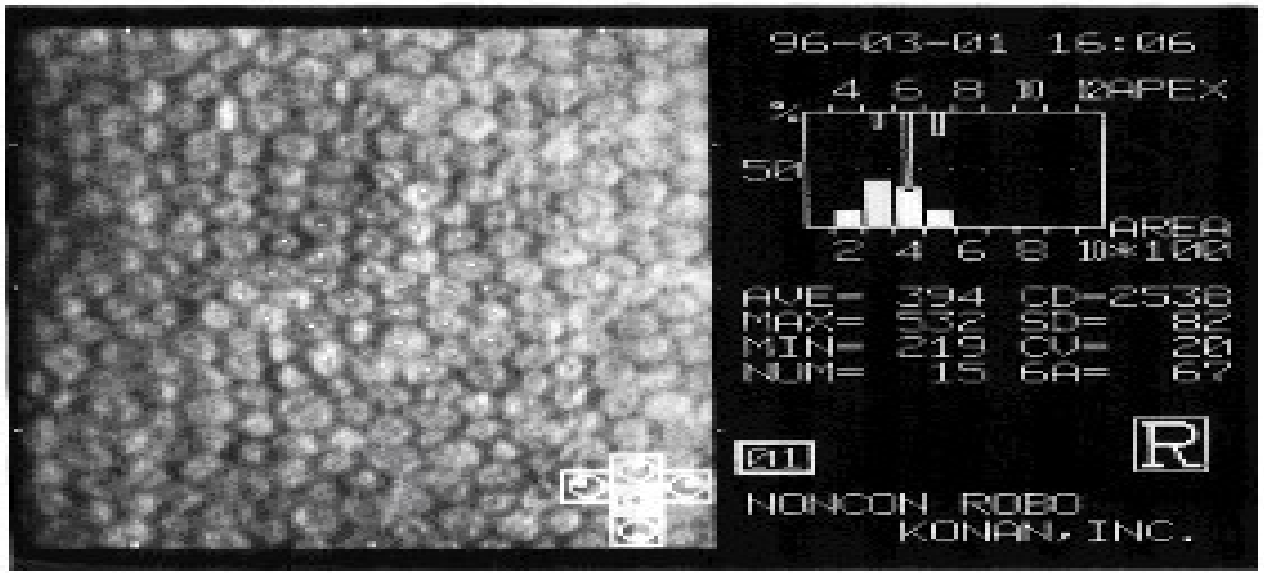


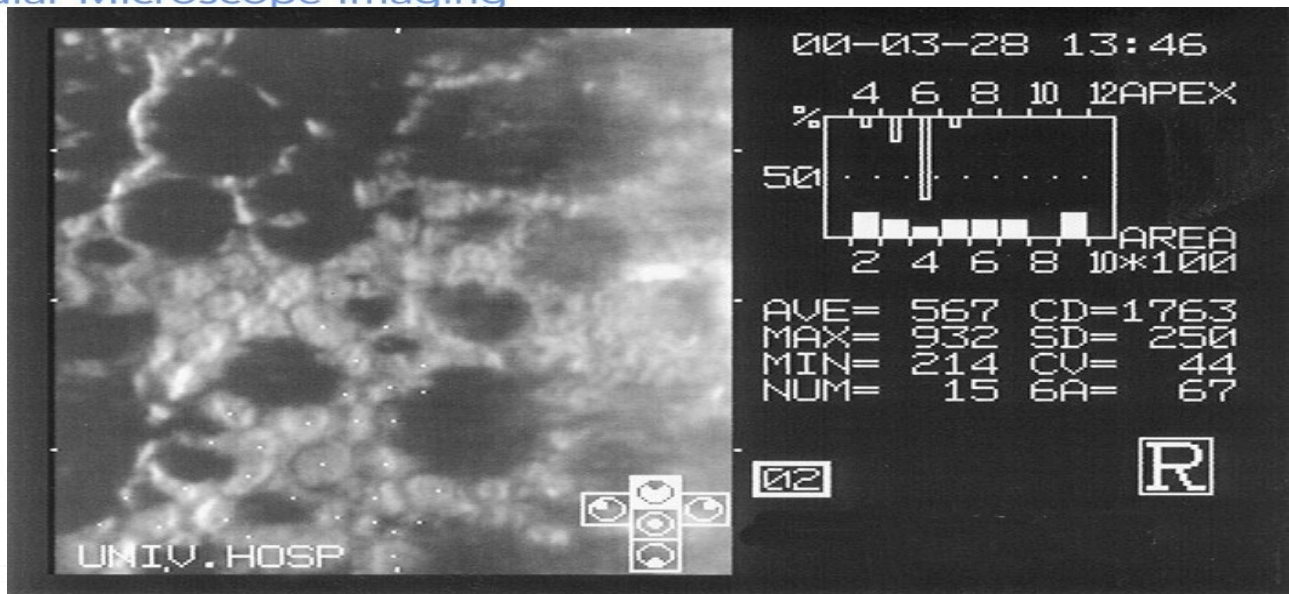
Polymegethism
EW Contact Lenses



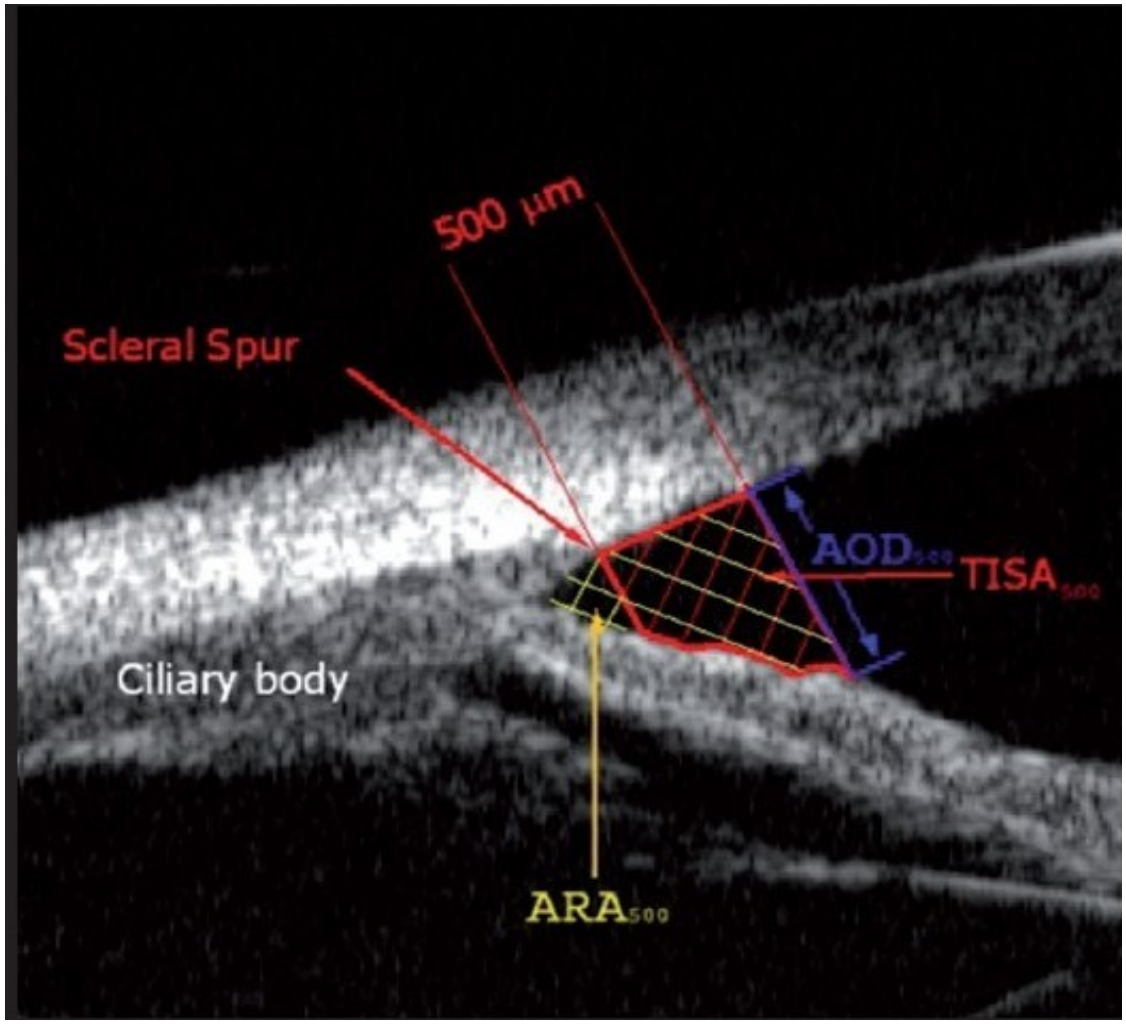
Stage 3 Guttata
Normal Cell Count

Konan CellChek™ Specular Microscope Imaging

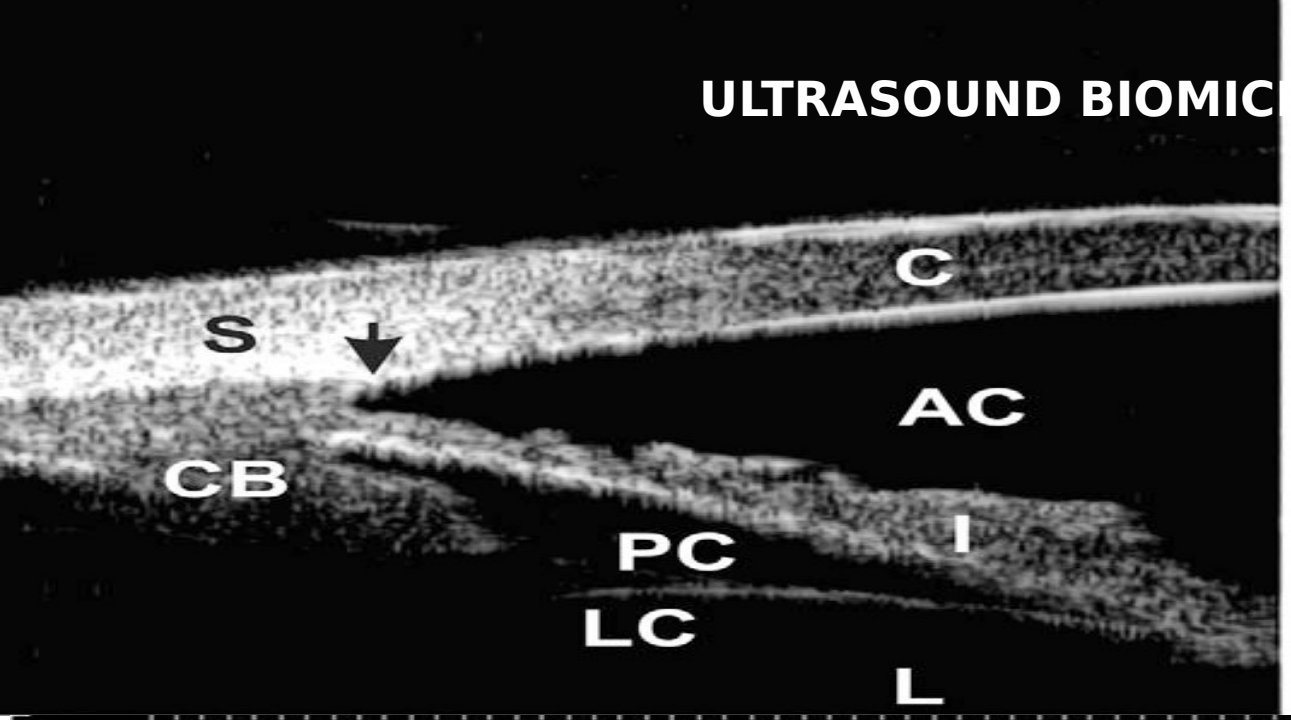


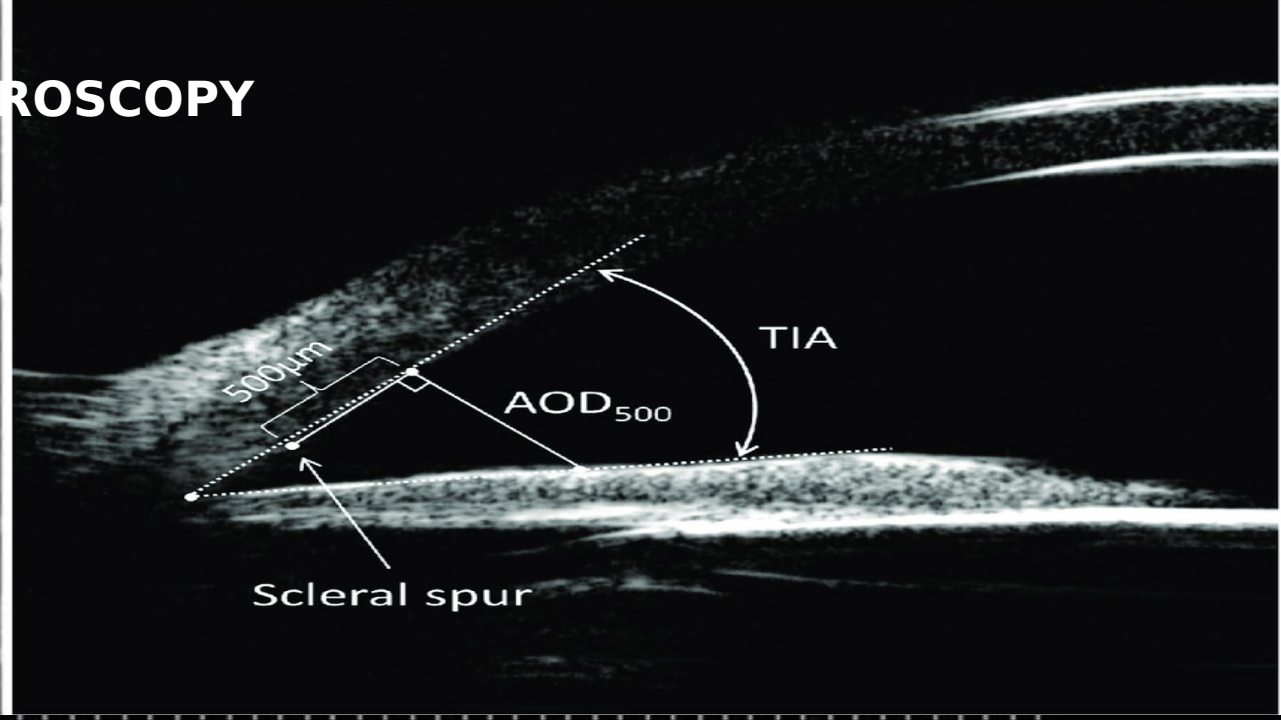


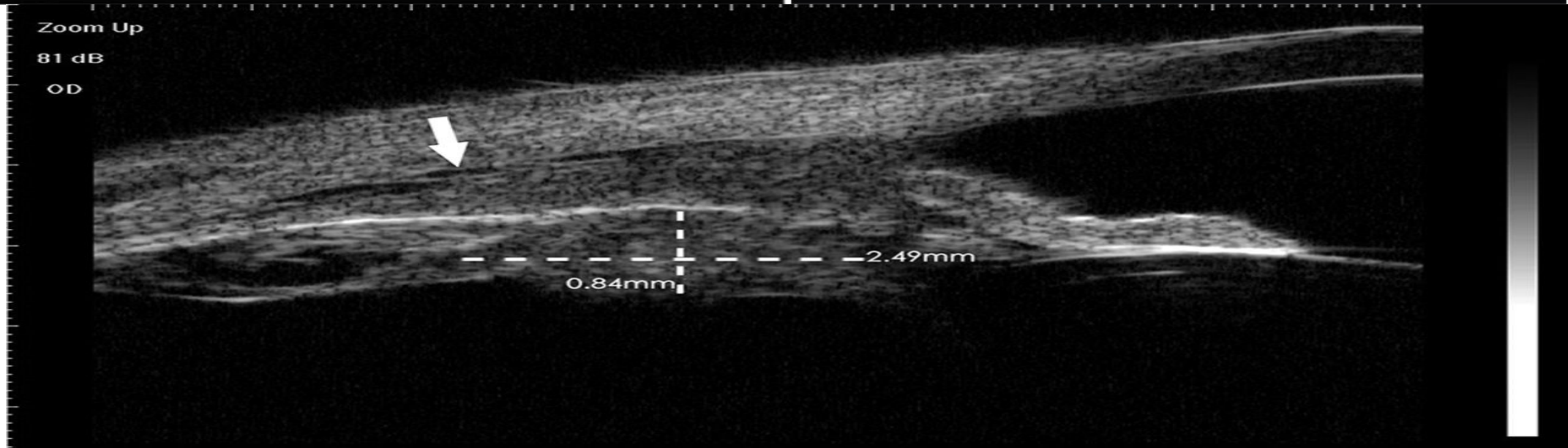
US Biomicroscopy



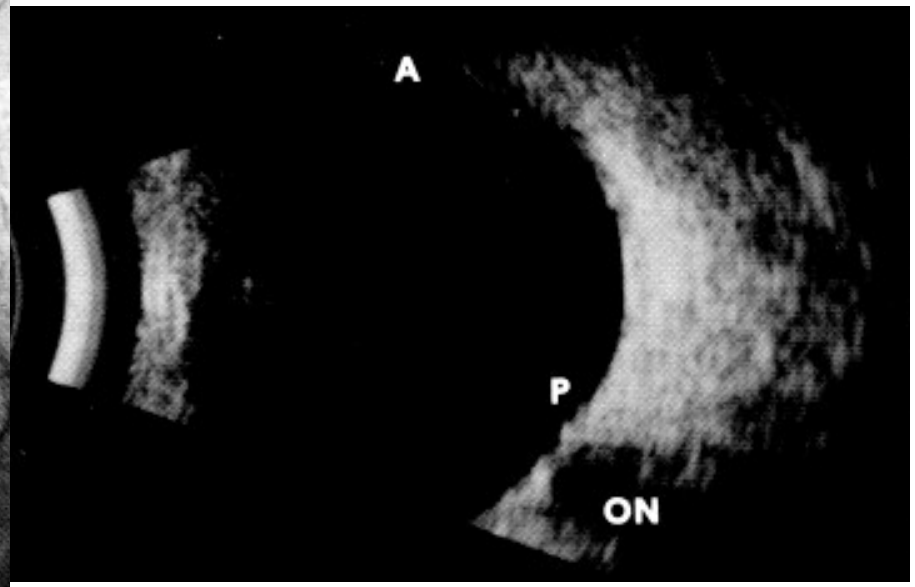
ULTRASOUND BIOMICROSCOPY



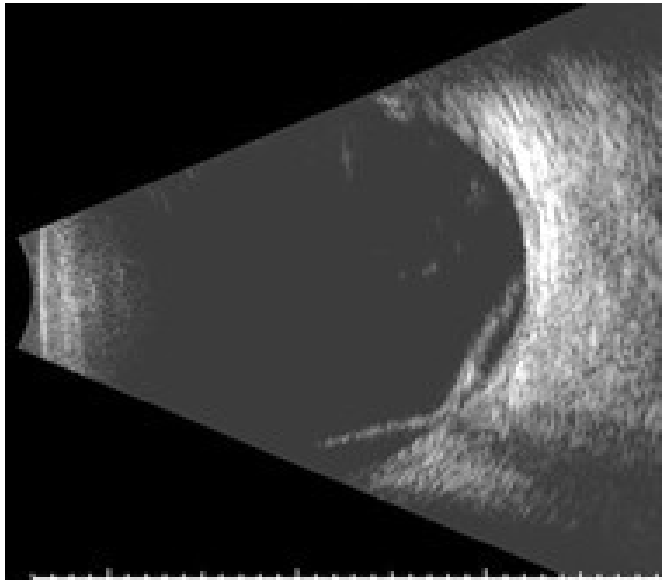




Ultrasonography (Echography)

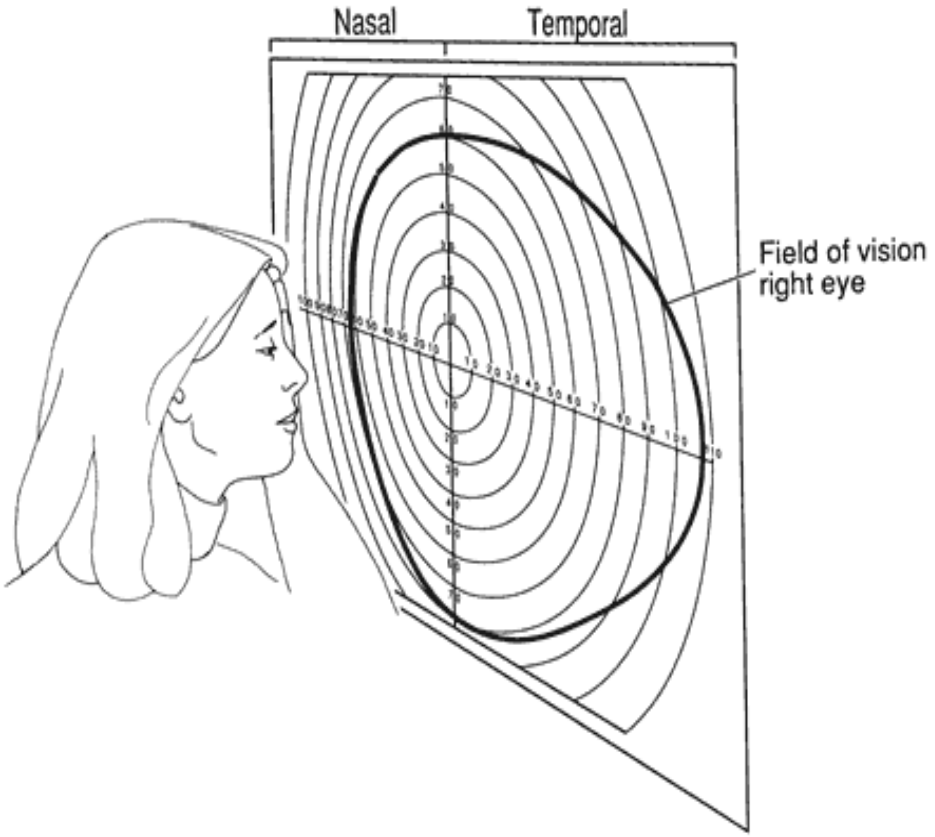


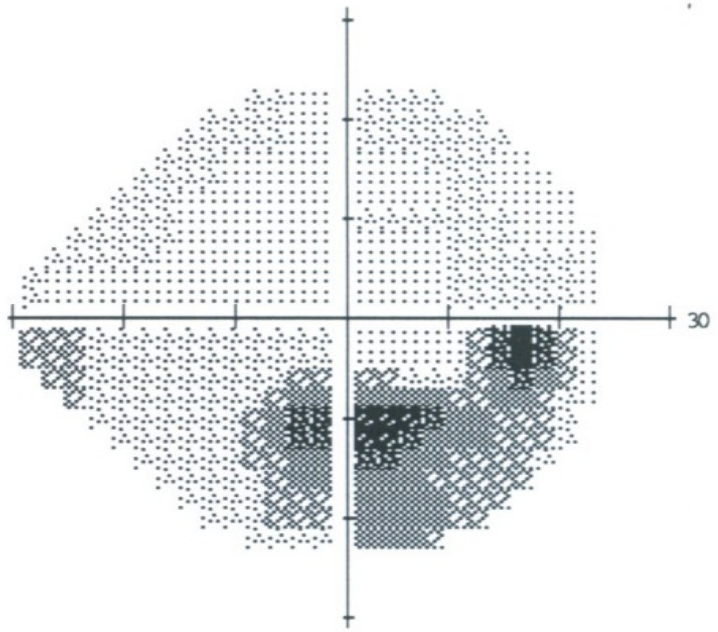
Normal

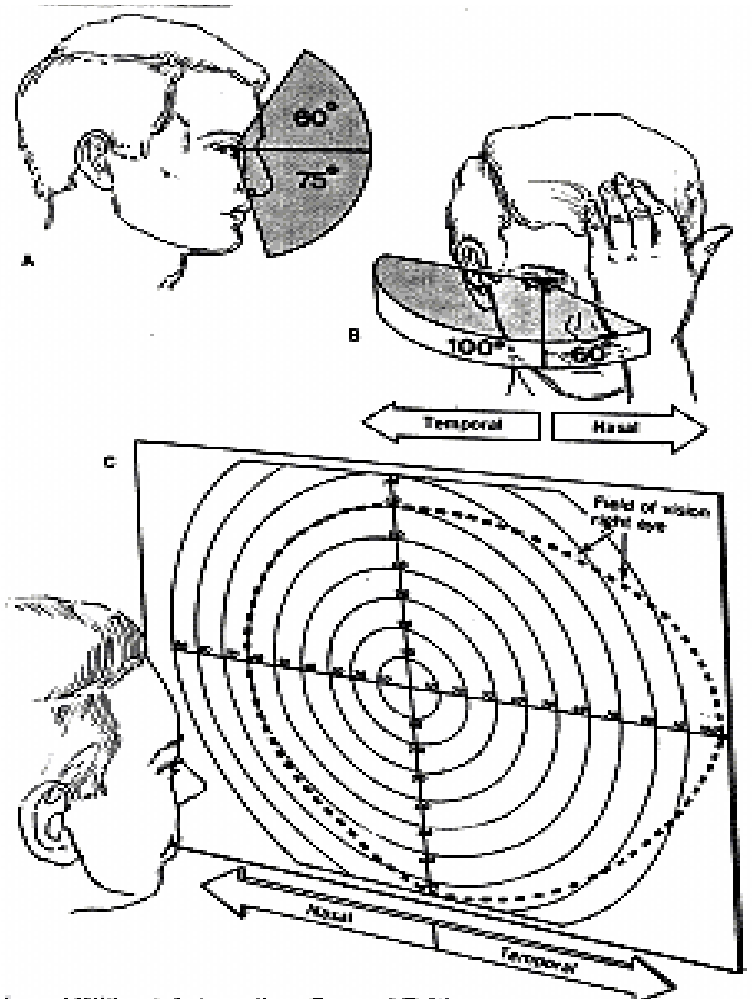


Retinal Detachment

Perimetry (Visual Field Test)







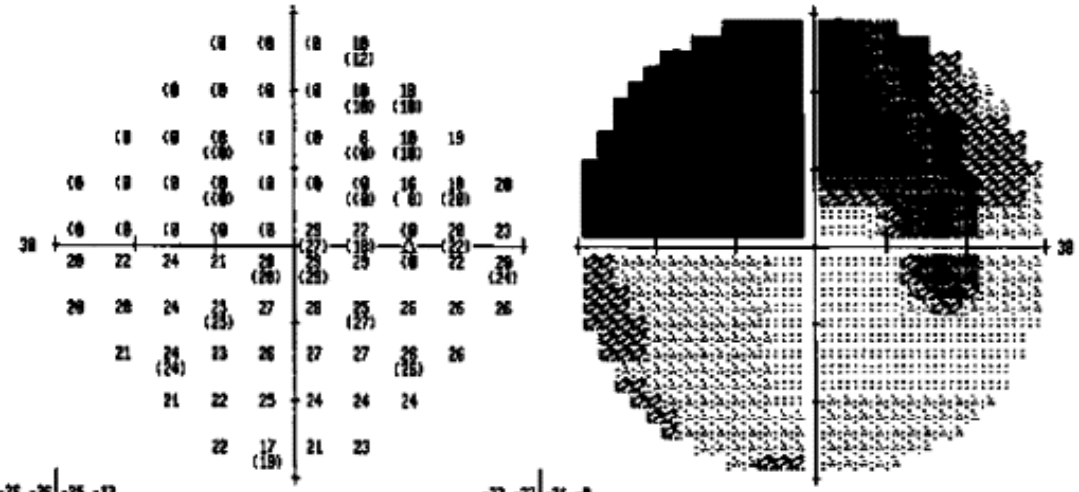
FIXATION MONITOR: BLINDSPOT
FIXATION TARGET: CENTRAL
FIXATION LOSSES: 1/23
FALSE POS ERRORS: 0/0
FALSE NEG ERRORS: 0/13
TEST DURATION: 13:22

FOVEA: 25 DB

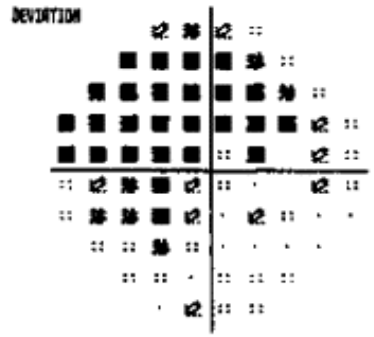
STIMULUS: III, WHITE
BACKGROUND: 31.5 ASB
STRATEGY: FULL THRESHOLD

PUPIL DIAMETER:
VISUAL ACUITY: 20/20
RX: +1.75 DS +1.50 DC X 20

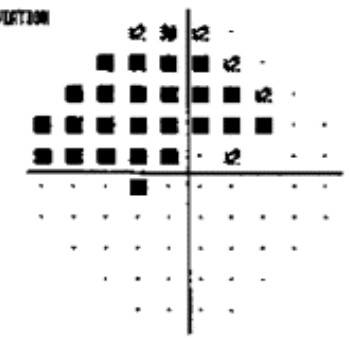
DATE: 06-26-17
TIME: 9:03 AM
AGE: 49



TOTAL DEVIATION



PATTERN DEVIATION



GHT
OUTSIDE NORMAL LIMITS

MD	-13.65 DB	P < 0.5%
PSD	13.42 DB	P < 0.5%
SF	8.56 DB	
CPSD	13.41 DB	P < 0.5%

:: P < 5%
P < 2%
P < 1%
P < 0.5%

ALTITUDINAL FIELD DEFECT

Single field analysis — Eye: left

Name: UL

Central threshold test 24-2

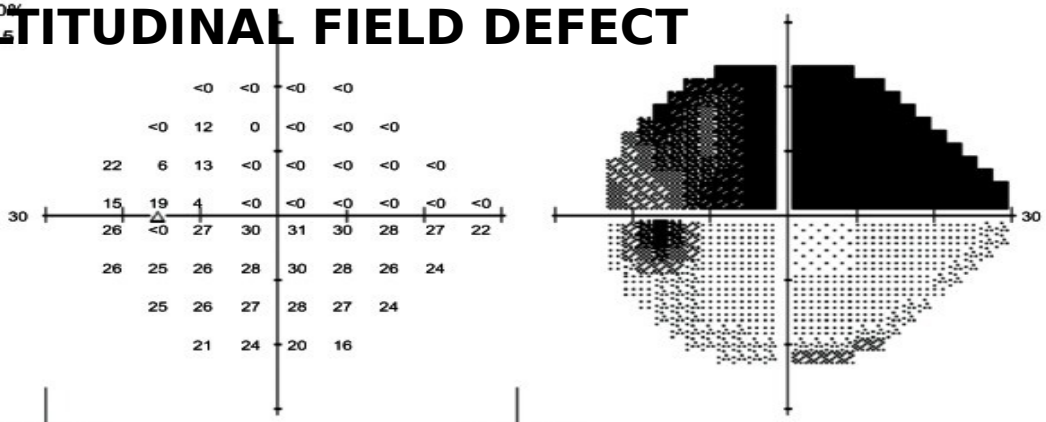
Fixation monitor: blindspot
Attachment target central
Fixation losses: 0/15
False Pos errors: 0%
False Neg errors: 0%
Test duration: 05:5

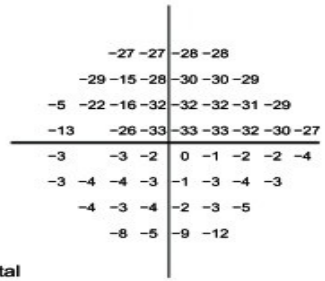
Stimulus: III, white
Depth: 31.5 ASB
Strategy: SITA-Standard

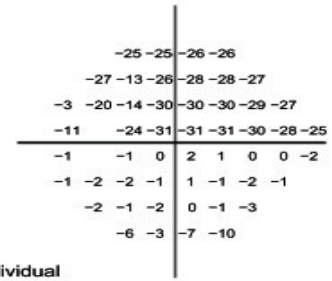
Pupil diameter: 3.4 mm
Visual acuity:
RX: +4.50 DS DC X

Date: 06-09-2012
Time: 09:09

Fovea: 35 dB







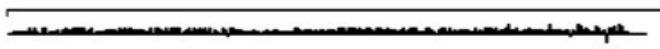
GHT
Outside normal limits

MD −14.48 dB $P < 0.5\%$
PSD 14.07 dB $P < 0.5\%$

Total deviation

Individual deviation

:: <5%
▒ <2%
▓ <1%
■ <0.5%



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HFA II 750-11687-4.1/4.1

HEMIANOPIC FIELD DEFECT

Single Field Analysis — Eye: Right

Name:
ID: leslie
DOB:

Central 30-2 Threshold Test

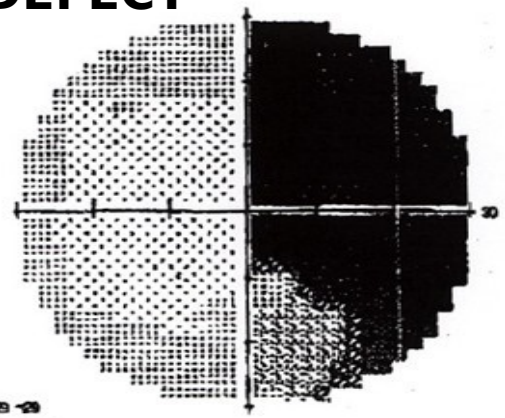
Fixation Monitor: Gaze/Blind Spot
Fixation Target: Central
Fixation Losses: 0/13
False POS Errors: 0%
False NEG Errors: 0%
Test Duration: 06:25

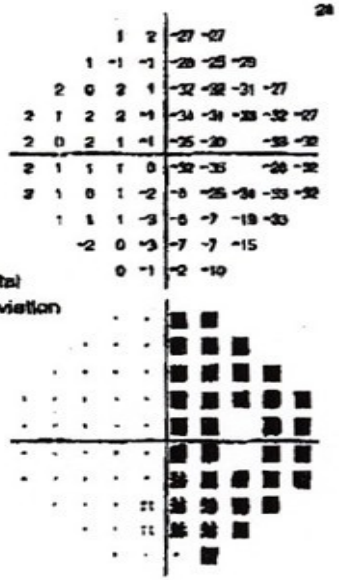
Stimulus: III, White
Background: 31.5 ASB
Strategy: SITA-Fast

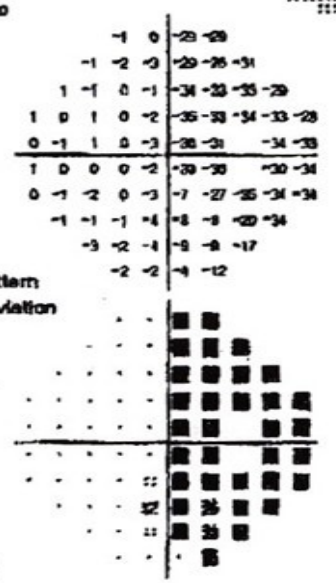
Pupil Diameter: 4.4 mm
Visual Acuity:
RX: +1.00 DS DC X

Date: 01-16-2008
Time: 3:45 AM
Age: 46

Fovea: 32 dB







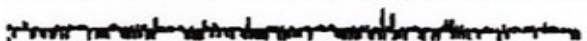
GHT
Outside normal limits

MD −10.41 dB $P < 0.5\%$
PSD 16.04 dB $P < 0.5\%$

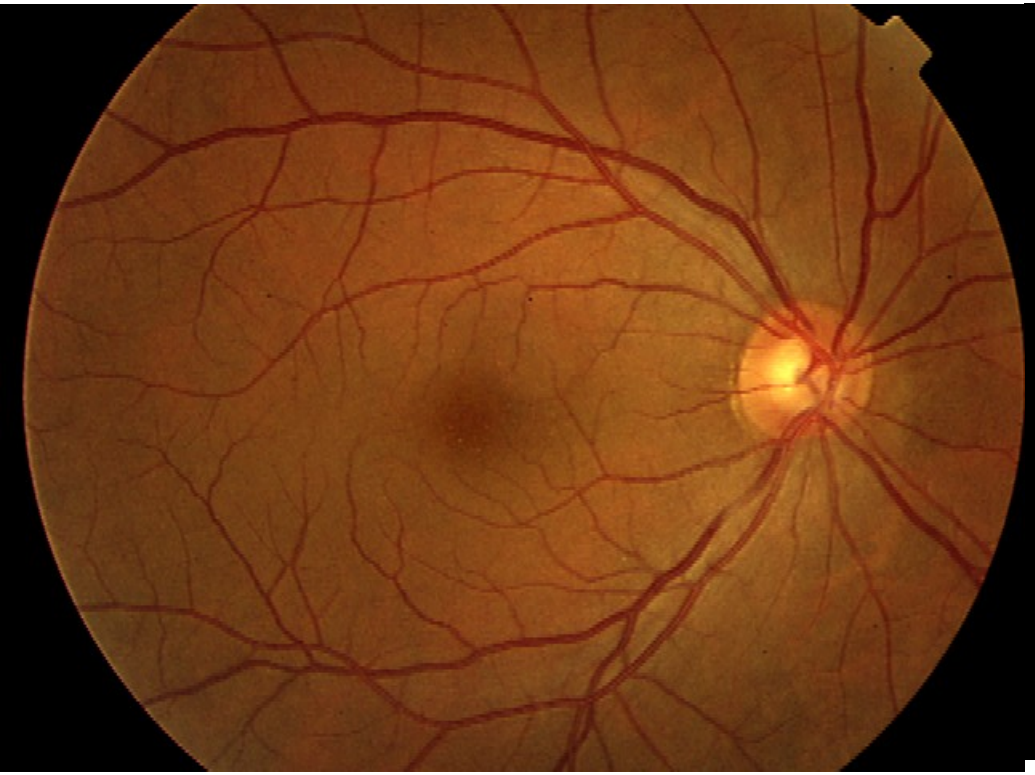
Total Deviation

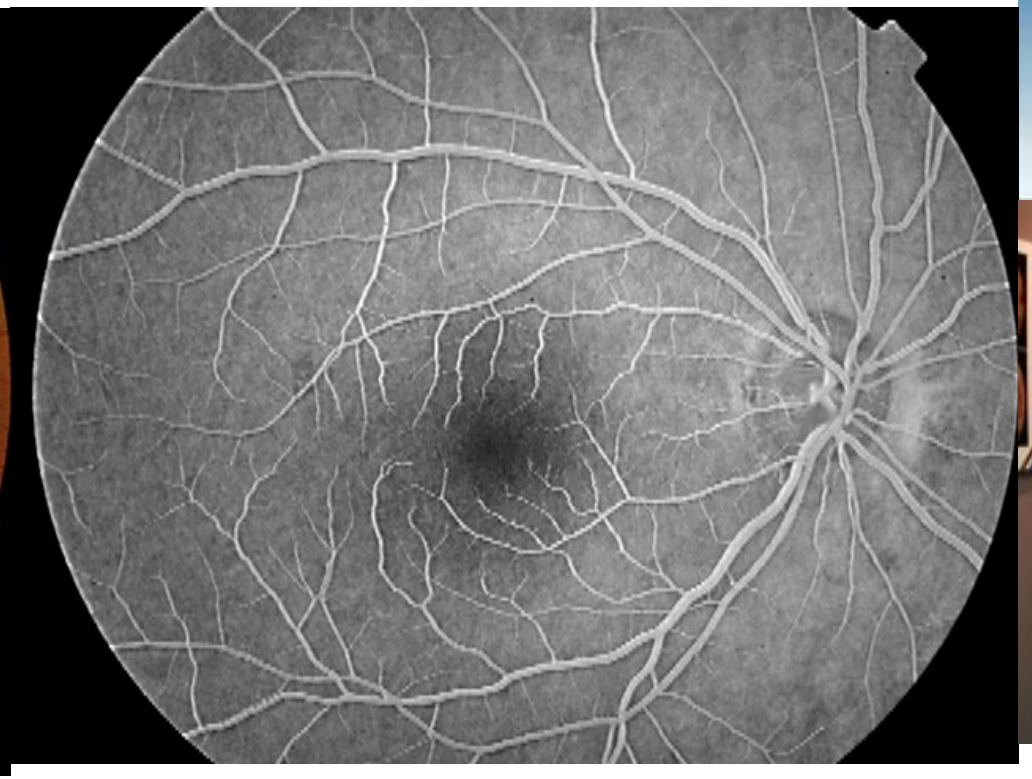
Pattern Deviation

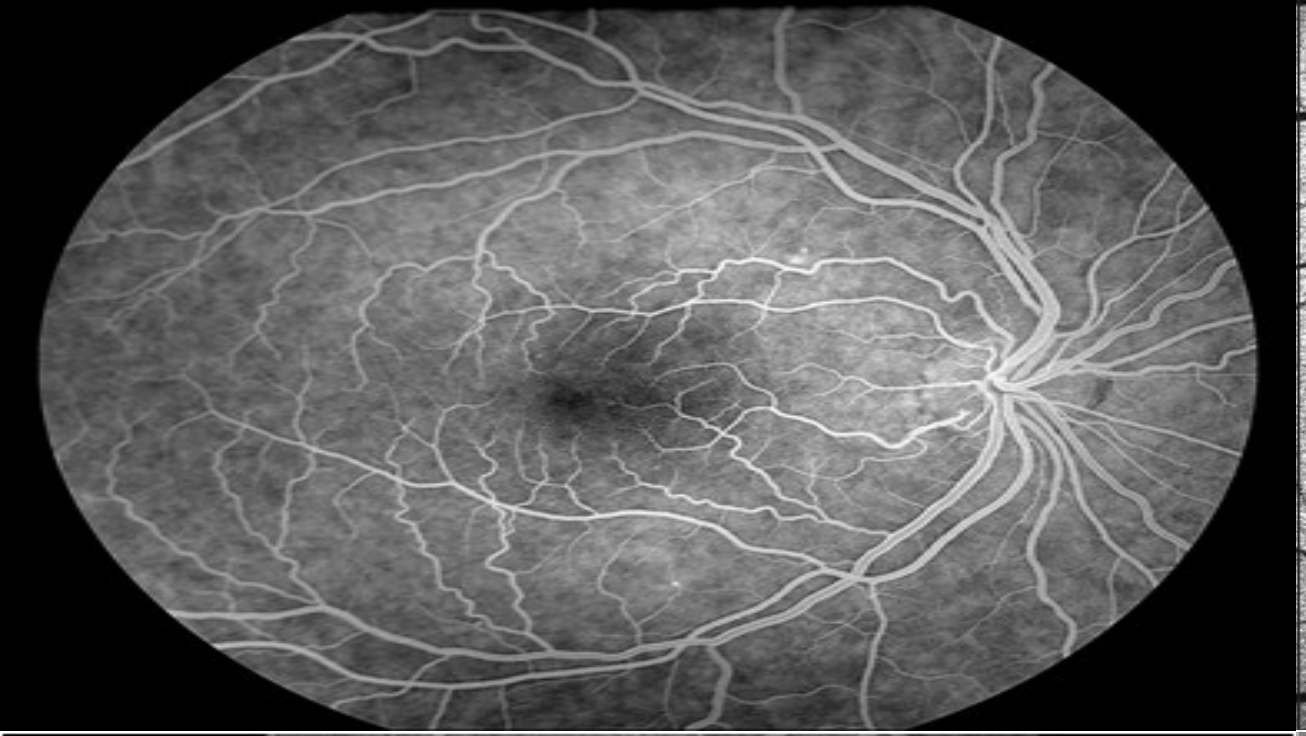
:: < 5%
▒ < 2%
▓ < 1%
■ < 0.5%

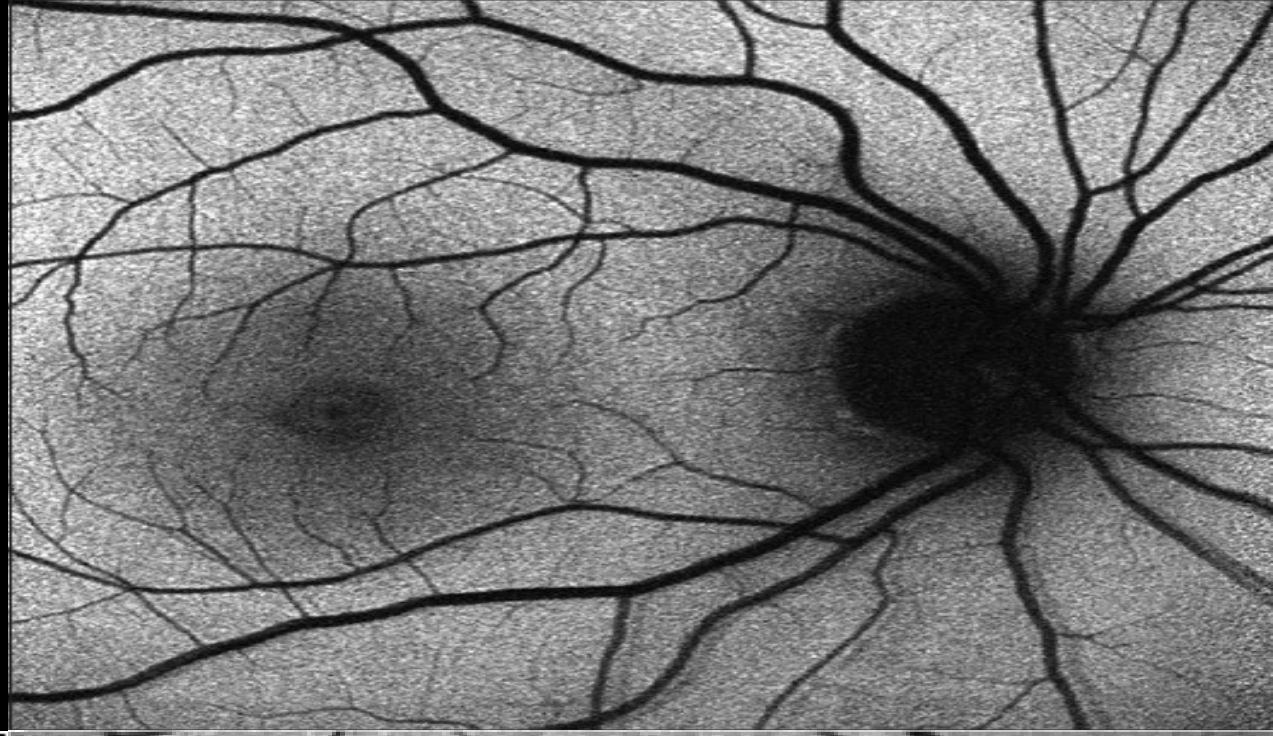


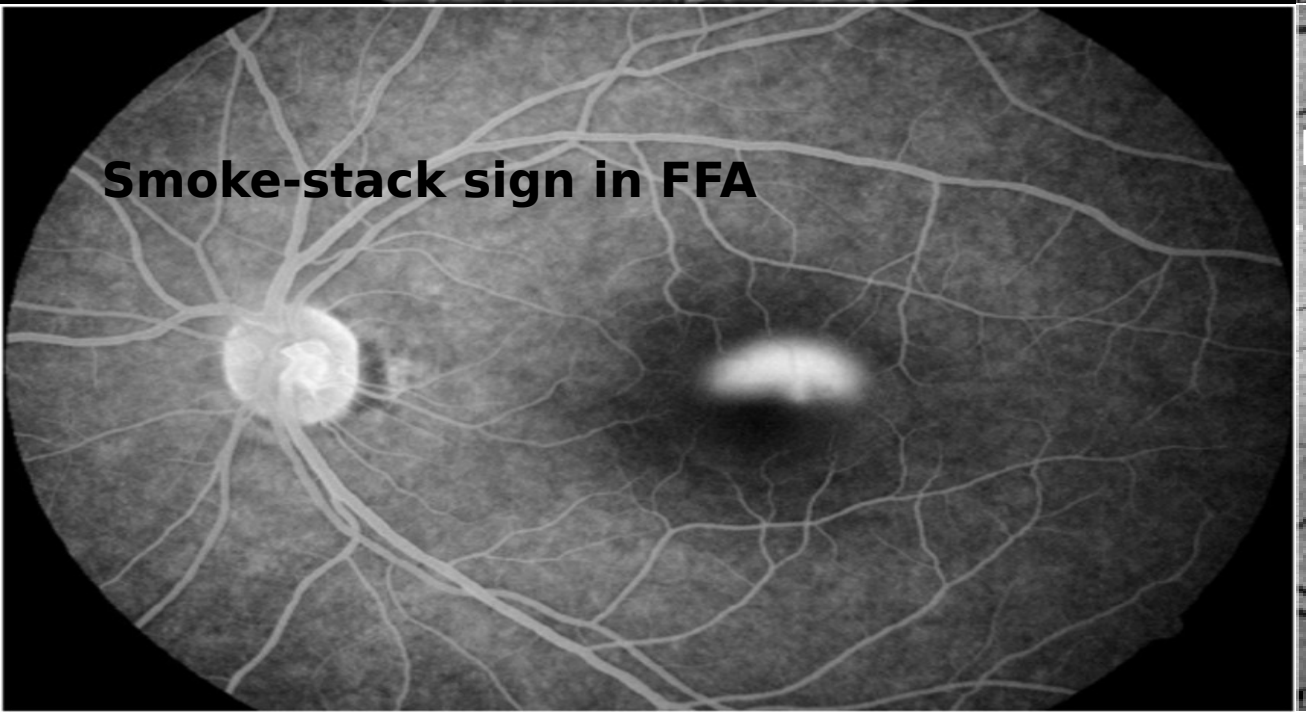
Fundus Fluorescein Angiography (FFA)

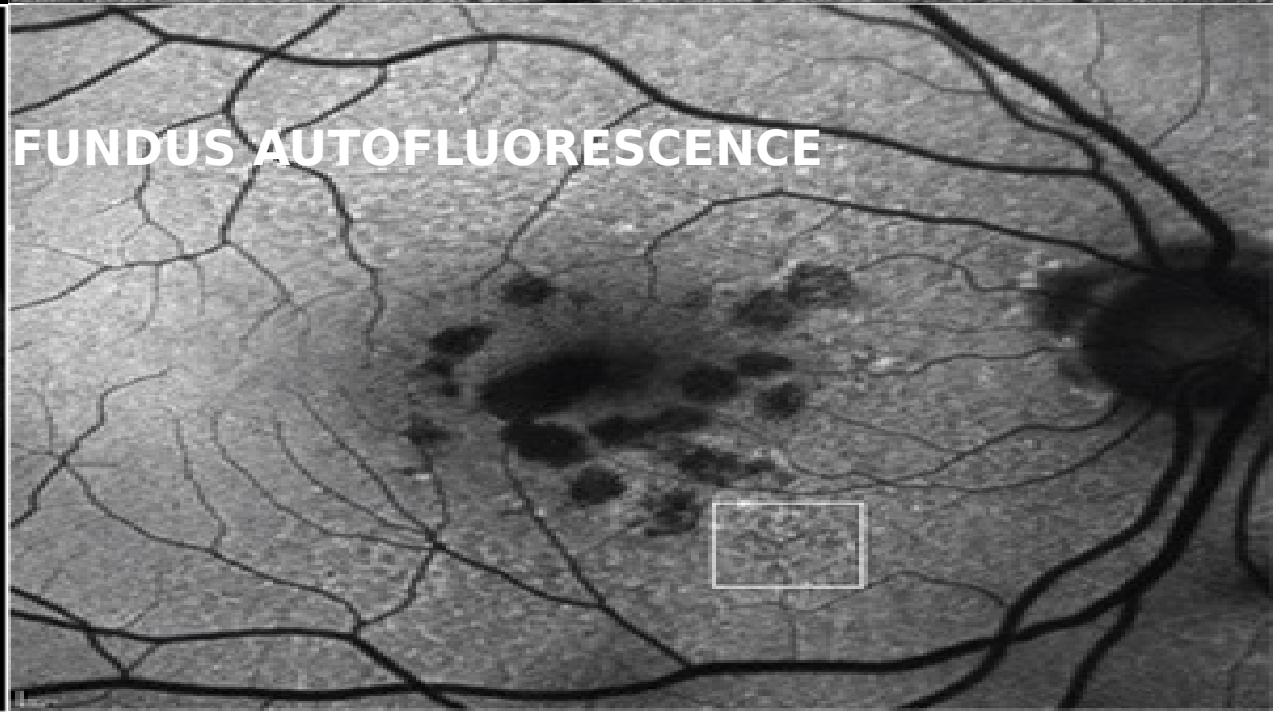




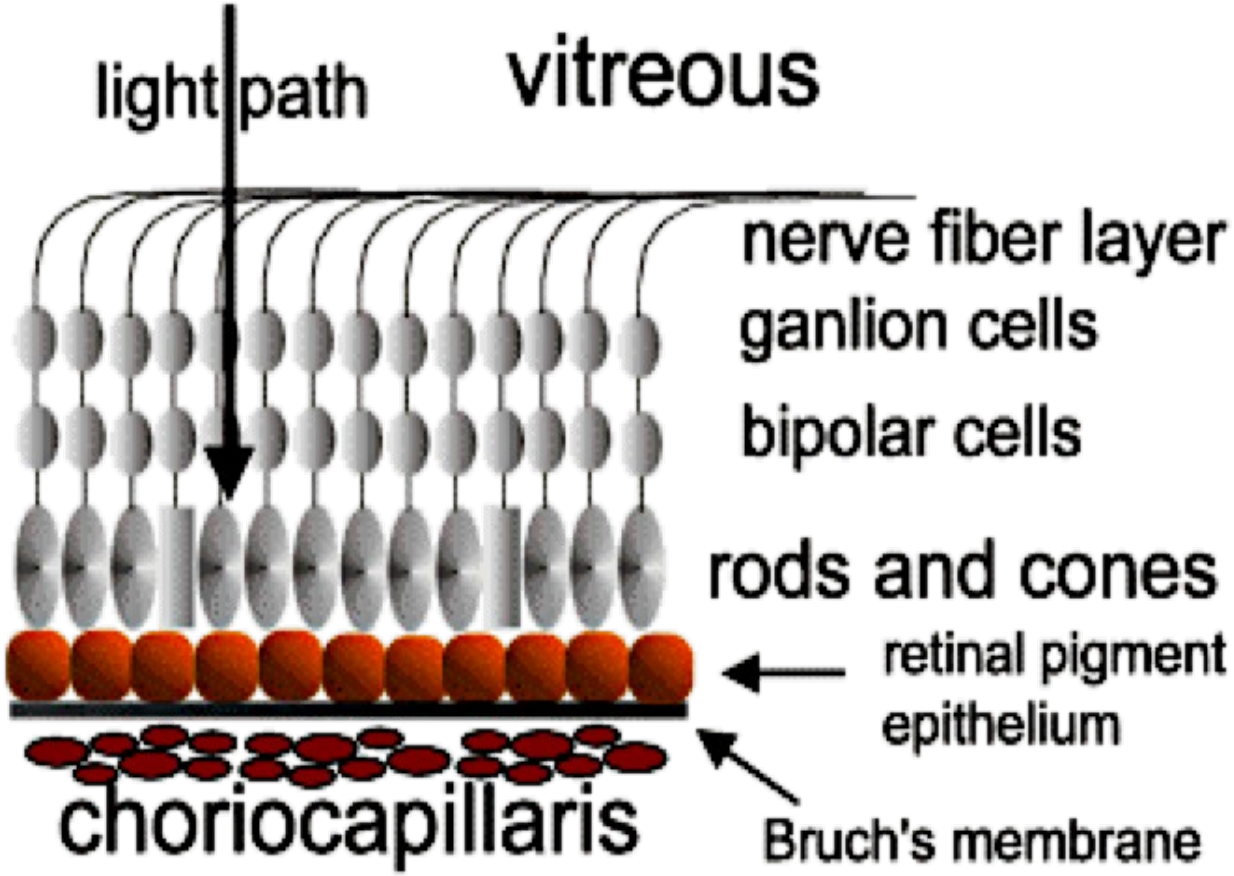


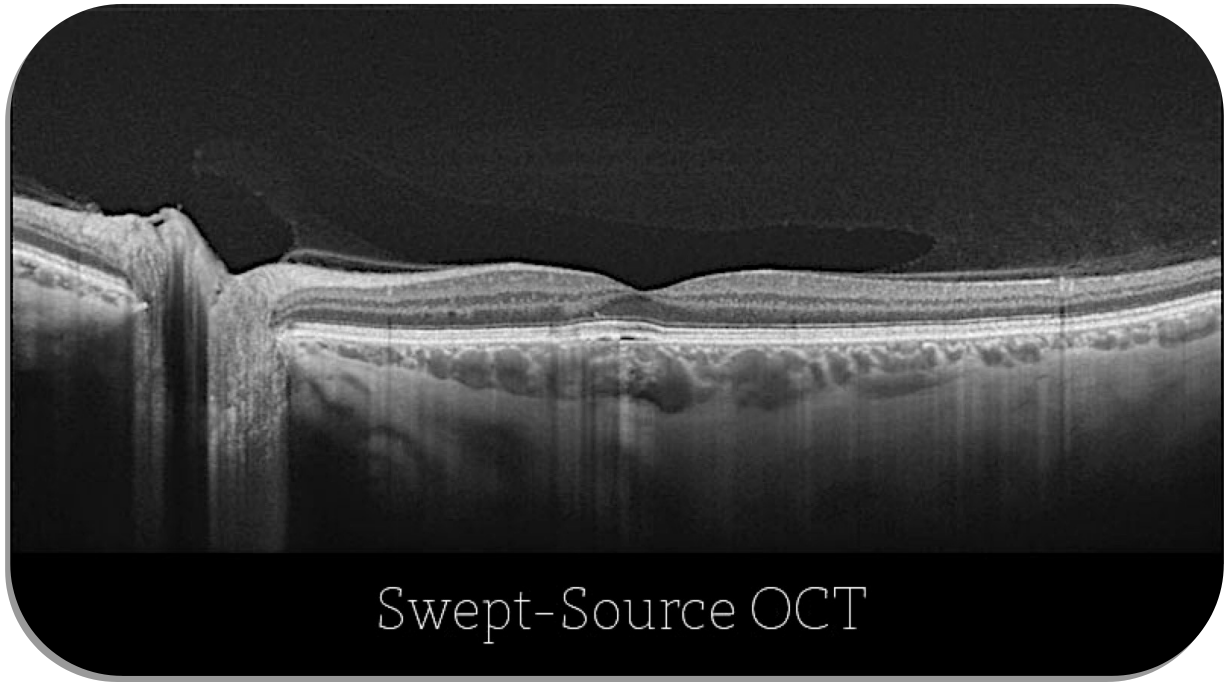


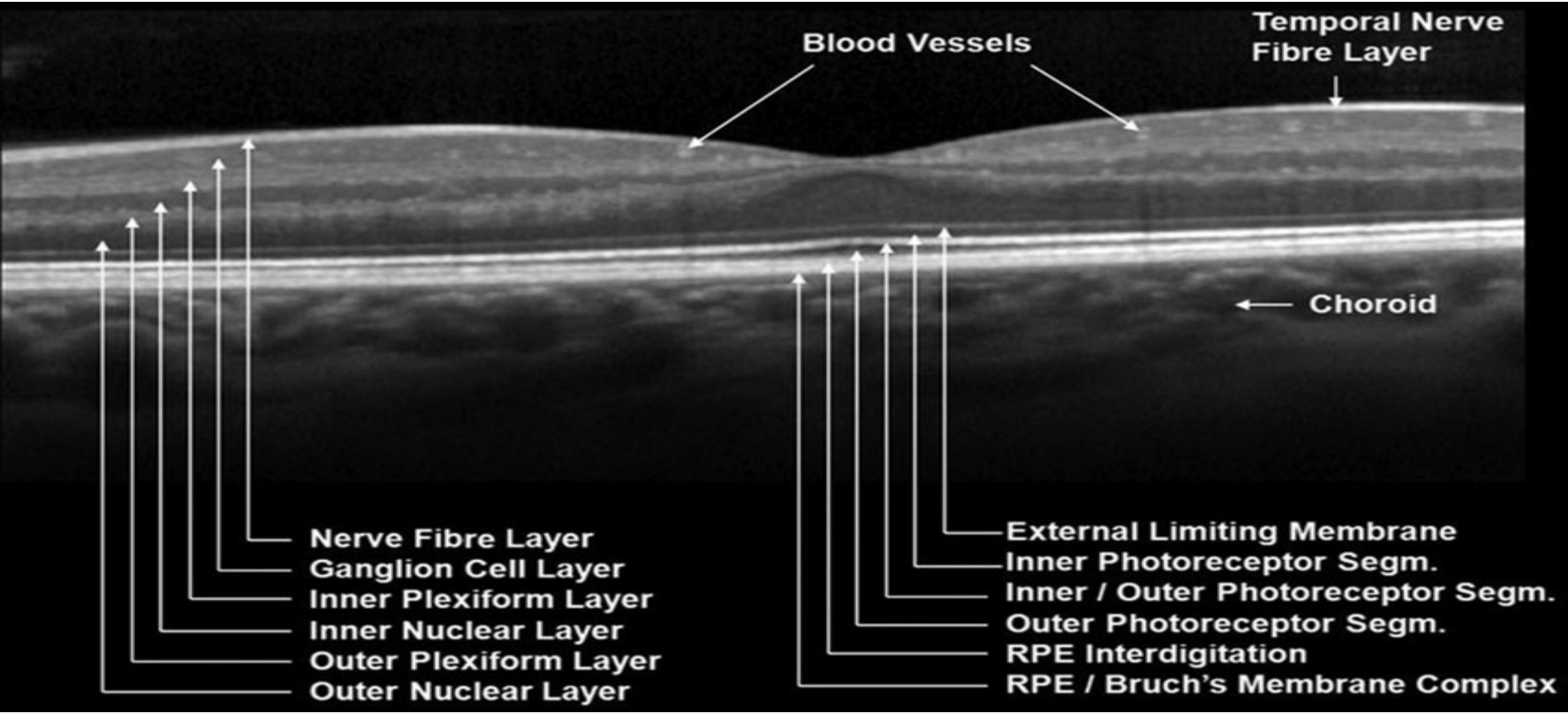

Smoke-stack sign in FFA

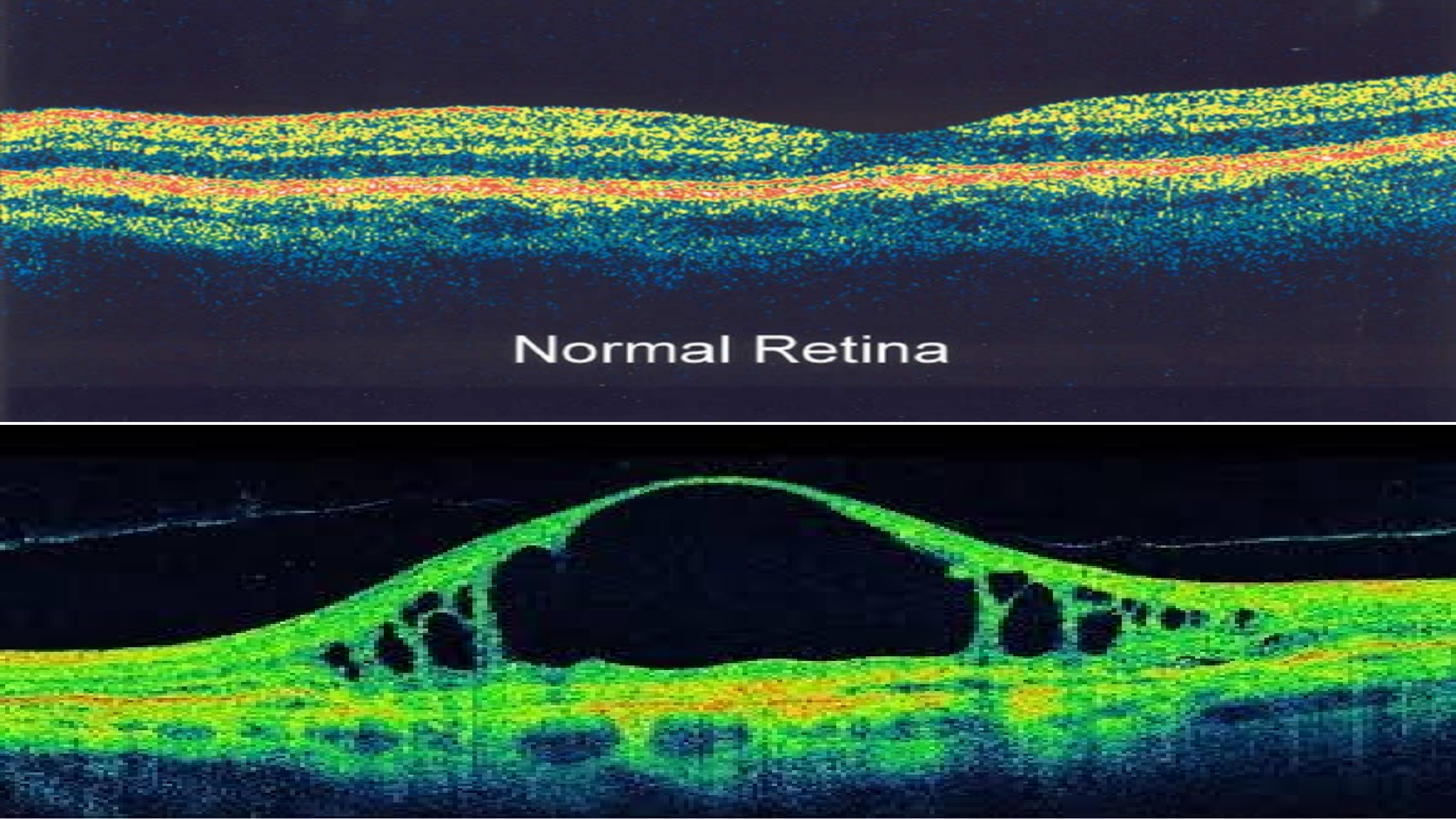

FUNDUS AUTOFLUORESCENCE

Optical Coherence Tomography (OCT)

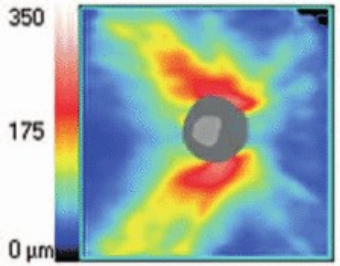





Blood Vessels
Temporal Nerve Fibre Layer
Choroid
Nerve Fibre Layer
Ganglion Cell Layer
Inner Plexiform Layer
Inner Nuclear Layer
Outer Plexiform Layer
Outer Nuclear Layer
External Limiting Membrane
Inner Photoreceptor Segm.
Inner / Outer Photoreceptor Segm.
Outer Photoreceptor Segm.
RPE Interdigitation
RPE / Bruch's Membrane Complex

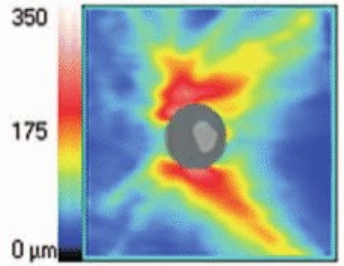

Normal Retina

RNFL Thickness Map

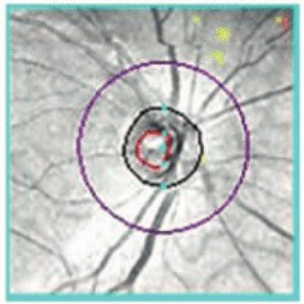


	OD	OS
Average RNFL Thickness	101 µm	101 µm
RNFL Symmetry	87%	
Rim Area	1.58 mm²	1.54 mm²
Disc Area	2.00 mm²	1.88 mm²
Average C/D Ratio	0.45	0.42
Vertical C/D Ratio	0.44	0.51
Cup Volume	0.077 mm³	0.081 mm³

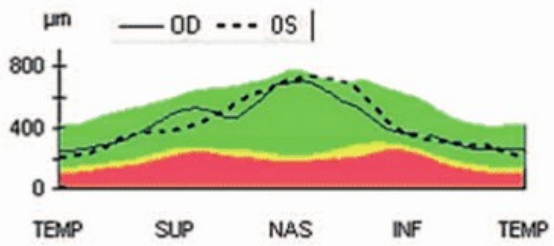
RNFL Thickness Map



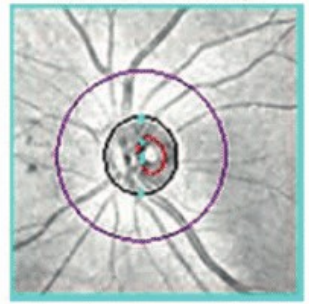
RNFL Deviation Map



Neuro-retinal Rim Thickness

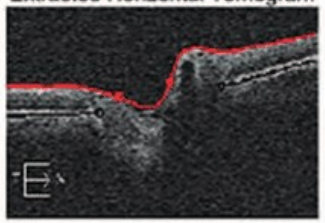


RNFL Deviation Map

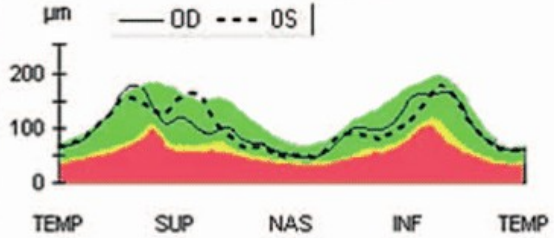


Disc Center(0.21,0.12)mm

Extracted Horizontal Tomogram

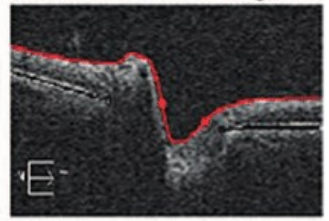


RNFL Thickness

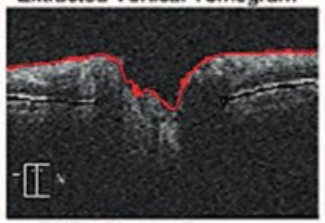


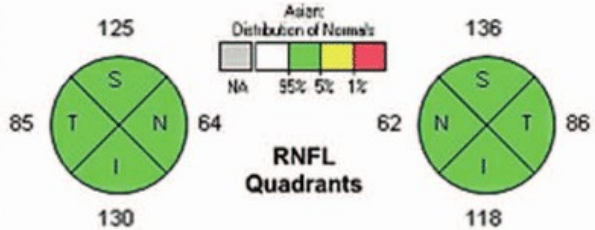
Disc Center(-0.33,-0.06)mm

Extracted Horizontal Tomogram

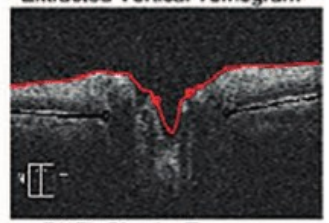


Extracted Vertical Tomogram

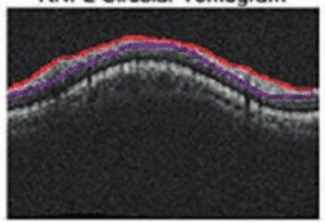


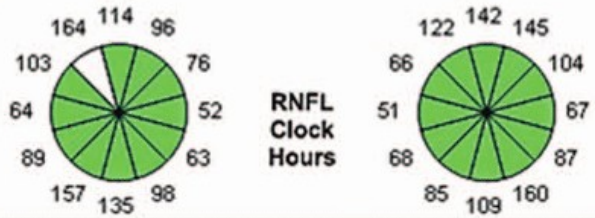


Extracted Vertical Tomogram



RNFL Circular Tomogram





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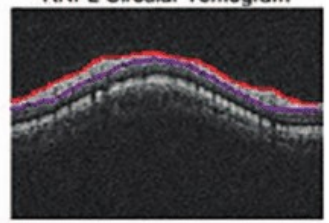
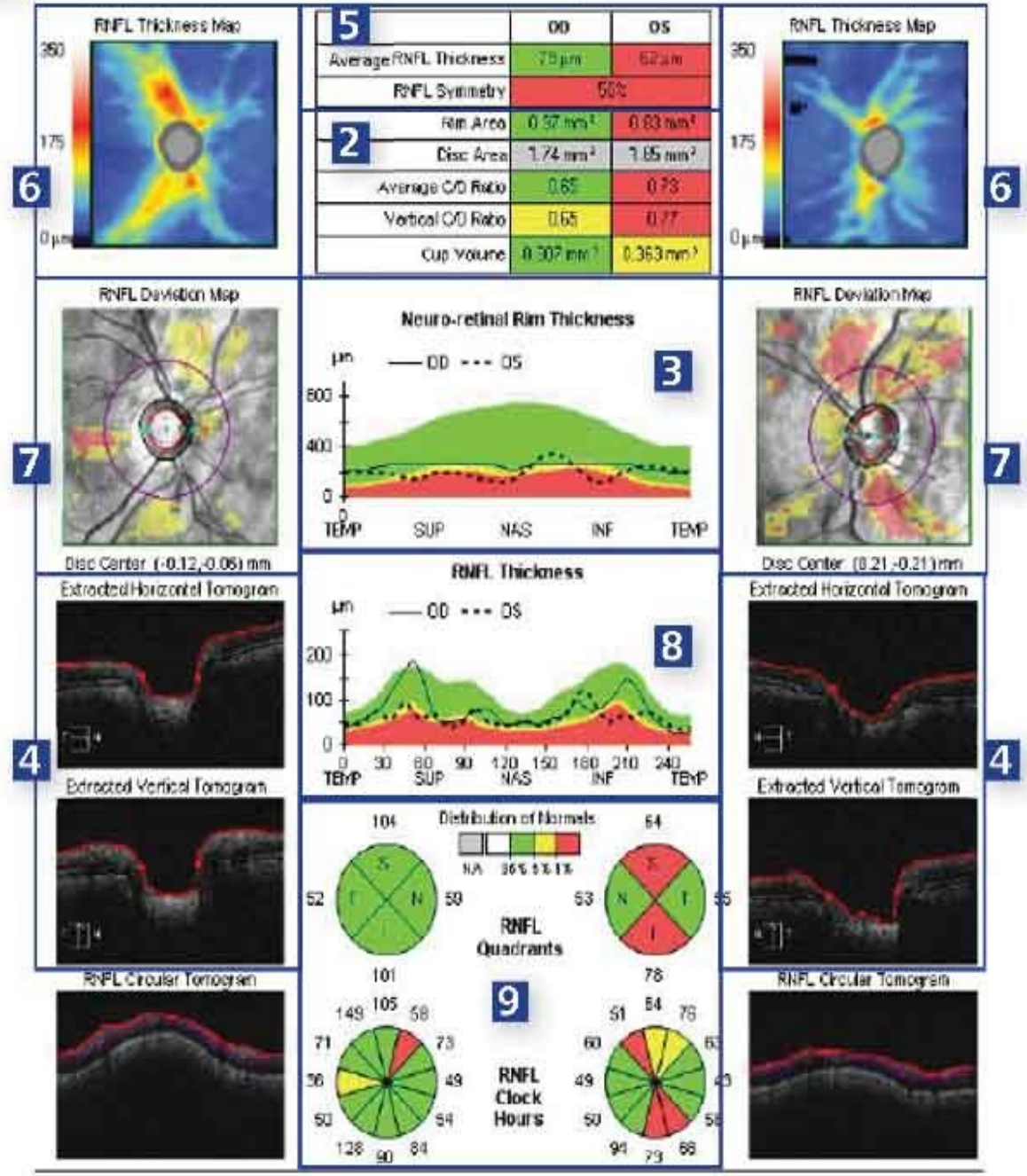
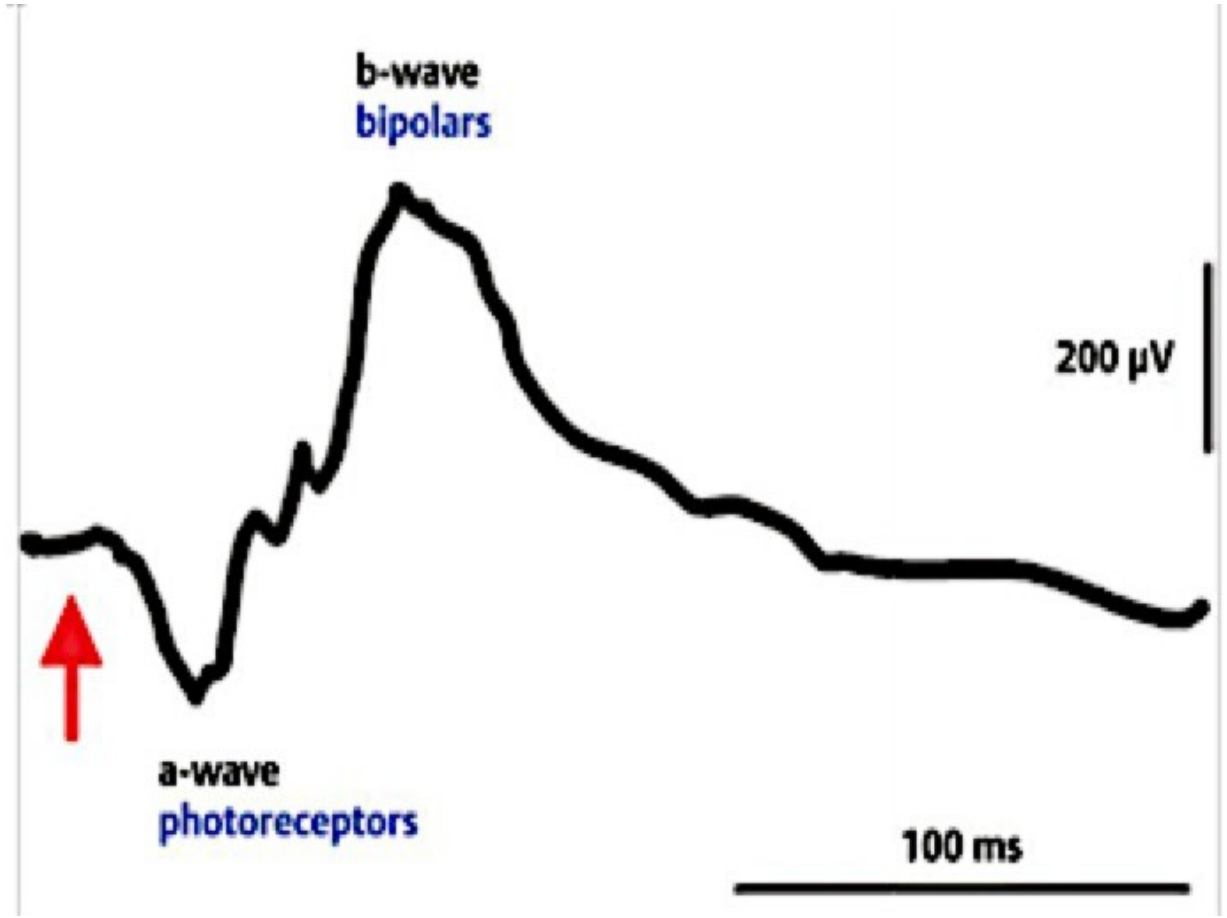
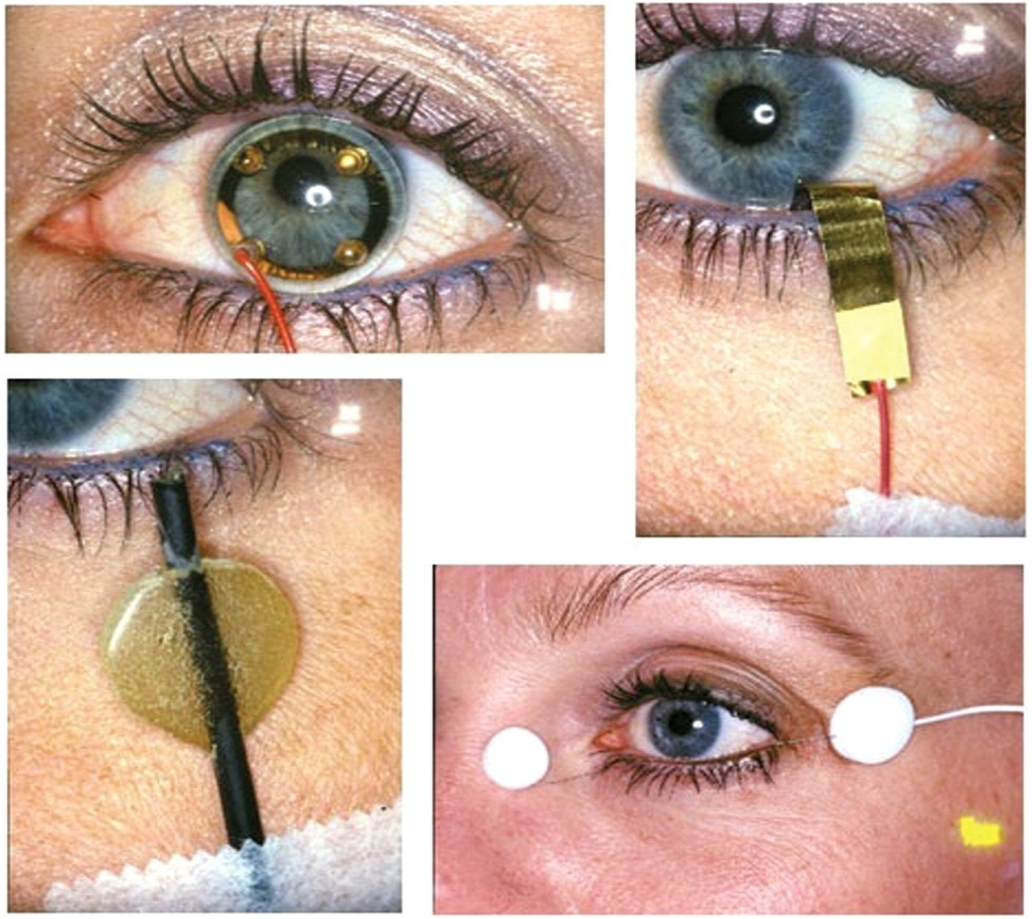


1 RNFL and ONH:Optic Disc Cube 200x200 OD OS

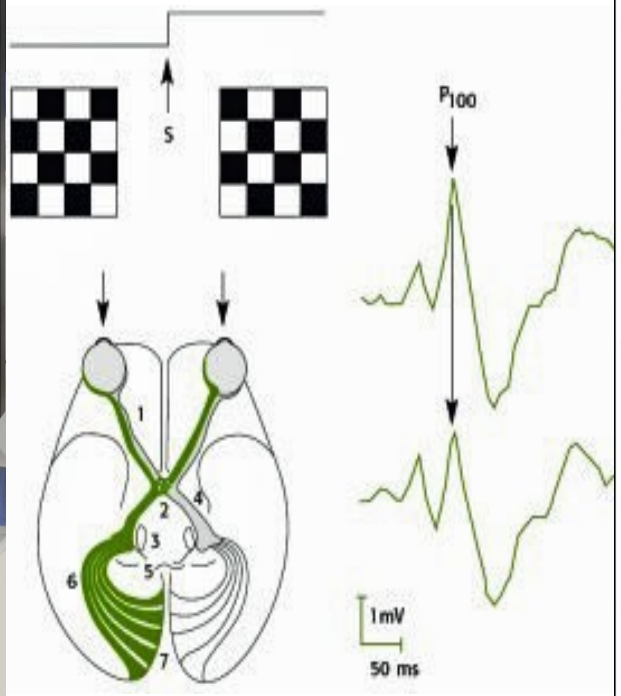


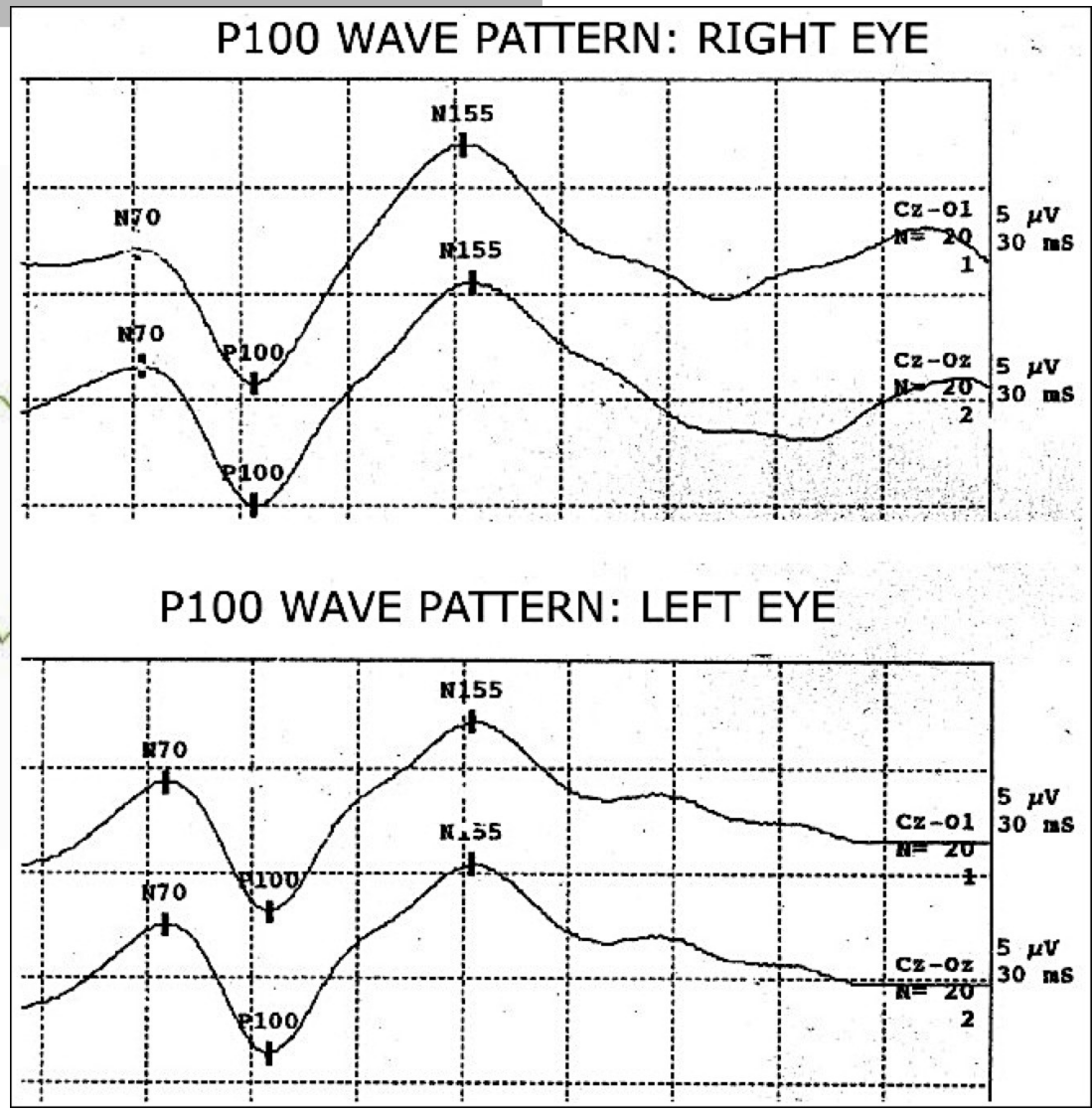
Electroretinography





Visual-Evoked potential





Blindness

- Functional definitions based on the measurement and quantification of visual acuity [VA] and visual field.

A central SCVA of **6/60** or worse in the better eye or a field defect, in which the field has contracted to such an extent that the widest diameter of visual field subtends an angular distance no more than **20°.**